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ABSTRACT

Designed to provide a model set of competencies, this manual presents tasks which were identified by employers, employees, and teachers as important in a postsecondary diesel vehicle maintenance curriculum. The tasks are divided into seven major component areas of instruction: chassis and suspension, diesel engines, diesel fuel, electrical, hydraulics, power trains, and service. For each of the 197 task statements, the task analysis identifies the competency required, the criterion of satisfactory performance, the skills or process the employee must have or follow in performing the task, the knowledge or theory one must know to perform the task effectively, and attitudes and values needed to be successful in carrying out the task. (The task inventory is appended.) (IRA)

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DIESEL VEHICLE MAINTENANCE

COMPETENCIES

CURRICULUM COMMITTEE

Robert Braswell
Sanford Garman
Thomas Heath
George Kahl
Joseph E. Clocker
George (Buster) Greene
Robert Israel
Marion Poythress
Roger Worthington

Technical Assistance:

Editing, Typing & Chart
Debbie Ray

Cover Art
William F. Pugh

CE 027 991

U.S. DEPARTMENT OF HEALTH,
EDUCATION & WELFARE
NATIONAL INSTITUTE OF
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August, 1980

DEPARTMENT OF COMMUNITY COLLEGES
OCCUPATIONAL PROGRAM SERVICES
RALEIGH, NORTH CAROLINA

FOREWORD

The Department of Community Colleges and the State Board of Education encourage the institutions in the System to maintain high-quality educational standards to assure that those who avail themselves of the educational opportunities offered in the System are prepared to meet the requirements of the jobs for which they train. To assure high-quality educational programs the State Board has instructed the Department to assist the institutions in the development of the competencies for each educational curriculum.

This document presents the job opportunities and competencies identified as those appropriate to the diesel vehicle and diesel equipment curriculums offered in the Community College System. The materials included are the results of the involvement of employers, employees, and educators and of many long, tedious hours of "homework" and committee work of instructors from the System.

This material is to be considered as a minimum standard. The material should provide guidance as a model to assist the curriculum planners in the institution in the development of the curriculum. Each institution offering a diesel curriculum is encouraged to organize and involve an advisory committee composed of employers and employees in the diesel world of work in the adaptation of these materials to the area being served.

PREFACE

In 1976 the Program Development Section, Department of Community Colleges, designed a competency-based curriculum development project using the task analysis technique as a proposal for the development of technical and vocational curriculums offered in the Community College System. This project was designed to involve employers, employees, and educators through use of surveys, curriculum committees, and advisory committees in determining the jobs and competencies in the diesel occupations.

These materials are primarily the work of the curriculum committee composed of diesel instructors in the Community College System. This committee was appointed by the Program Development Section. The members were selected from persons nominated by the presidents and deans of institutions offering diesel curriculums in the System.

The Committee proceeded as set forth in the project to: develop a list of jobs in which graduates of the curriculums may find employment; develop a survey to include all the tasks diesel mechanics perform on the jobs; conduct and analyze the survey; write competencies and criterion measures for each of the tasks; and analyze the tasks for skills, knowledge and values to be taught.

The curriculums offered in the System today are Diesel Vehicle Maintenance, Diesel and Equipment Technology, and Heavy Equipment Mechanics (Earthmoving). This project is primarily concerned with Diesel Vehicle Maintenance and those elements which are core among the three programs. A future study will add the Diesel and Equipment Technology and the Heavy Equipment (Earthmoving) components.

The intent of this manual is to provide a model set of competencies based on input from employers, employees, and educators. Each institution should involve an advisory committee in adapting these materials to a curriculum that will prepare individuals to perform the competencies and criterion levels identified. These competencies are to be considered as minimum for each curriculum offered in the System. The institutions are encouraged to examine local needs and adapt the competencies to include local needs.

It is recommended that consideration be given to implementing the ideas presented herein as they are based upon the experience, insight, advice, and work of instructors in the System.

ACKNOWLEDGMENTS

The Curriculum Committee

The Curriculum Committee was composed of instructors from the Community College System. These instructors were nominated to serve on the committee by the president of their institution. This committee was the working committee and was responsible for writing and approving the materials that were included in this document. Each of these persons is to be commended for his extra work in developing these materials.

Robert Braswell
Wayne Community College
Goldsboro, NC

Joseph E. Clocker
Johnston Technical Institute
Smithfield, NC

Sanford Garman
Central Piedmont Community College
Charlotte, NC

George (Buster) Greene
Southeastern Community College
Whiteville, NC

Thomas Heath
Beaufort County Community College
Washington, NC

Robert Israel
Asheville-Buncombe Technical College
Asheville, NC

George Kahl
Forsyth Technical Institute
Winston-Salem, NC

Marion Poythress
Cape Fear Technical Institute
Wilmington, NC

The Writing and Editing Committee

A special writing and editing committee was established to review, edit, and rewrite all the competency-based curriculum materials. This committee's role was to insure that all the materials were written in the same style and format, and to carefully edit for consistency and correctness of all materials. In addition to the regular committee meetings and home assignments, this group spent many days carefully carrying out their assignments. The Community College System is indebted to them for their dedication and sincere efforts.

Robert Braswell

Joseph E. Clocker

George Kahl

Roger G. Worthington, Project Coordinator

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INTRODUCTION

Diesel curriculums first offered in the Community College System related primarily to the heavy truck industry. They were designed to prepare individuals to enter the trucking industry as truck mechanics and in other industries as diesel engine mechanics. In recent years these programs have been expanded to serve the growing employment needs in the heavy equipment industry for diesel and heavy equipment mechanics. Many of the automotive mechanics curriculums have also added instructional components in diesel engines to their curricula to prepare the auto mechanics graduate for employment in the diesel automobile fields. As the System's capabilities have developed to expand these programs, the need has increased to involve representatives from a broader spectrum of the diesel industry and to expand the programs to provide educational opportunities in specialty diesel fields of employment. There is also the need to keep close and continuing contact with employers to assure that education is preparing employees to meet employment requirements. This project's purpose was to review and evaluate the competencies needed today in the field of diesel maintenance to assure that programs in the System continue to improve in quality.

JOB TITLES

DICTIONARY OF OCCUPATIONAL TITLES

The Dictionary of Occupational Titles (DOT) includes standardized and comprehensive descriptions of job duties of more than 20,000 occupations in the United States. The occupational titles in the DOT have been carefully reviewed and those most commonly related to the competencies included in this manual on Diesel Vehicle Maintenance have been selected to be included. Most of the titles selected are for those occupations where entry-level skills are at the apprentice level. Some titles, however, are listed for which the basic knowledge and skills are taught but the individual will need work experience before being fully qualified. Also, one needs to recognize that these titles are comprehensive and that each employer may have different titles and responsibilities for the jobs within the firm. Some titles have been listed also for occupations in related fields whereby persons completing these competencies will have entry-level skills to enter the occupation.

625.281-010 DIESEL MECHANIC (any ind.)

Repairs and maintains diesel engines used to power machines, such as buses, ships, trucks, railroad trains, electric generators, and construction machinery, using handtools, precision-measuring instruments, and machine tools: Diagnoses trouble, disassembles engines, and examines parts for defects and excessive wear. Reconditions and replaces parts, such as pistons, bearings, gears, valves, and bushings, using engine lathes, boring machines, handtools, and precision-measuring instruments. May be designated according to type of diesel engine or equipment repaired as Diesel-Engine Mechanic, Automobile; Diesel-Engine Mechanic, Bus; Diesel-Engine Mechanic, Truck; Diesel-Mechanic, Construction; Diesel-Mechanic, Farm; Locomotive Repairer, Diesel.

625.281-014 DIESEL-MECHANIC APPRENTICE (any ind.) Diesel-Engine-mechanic apprentice.

Performs duties as described under Apprentice (any ind.)

625.684-010 DIESEL-MECHANIC HELPER (any ind.)

Assists Diesel Mechanic (any ind.) in overhauling and maintaining diesel motors used to operate trucks, generators, and other equipment: Disassembles motor and cleans parts. Obtains parts from stock and hands tools to mechanic. Assists in reassembly, and cleans tools and working area. Performs other duties as described under Helper (any ind.).

625.281-022 FUEL-INJECTION SERVICER (any ind.)

Rebuilds, tests, and calibrates fuel injection units as used on diesel engines, railroad locomotives, trucks, construction equipment, tractors, and power plants: Studies repair order and disassembles unit to determine cause of malfunction. Refinishes defective parts, using lapping machine to grind and smooth nozzle point and seat. Replaces parts which cannot be refinished. Assembles and calibrates injection pumps, using test equipment. Assembles and tests nozzle assemblies, using test equipment.

620.381-022 REPAIRER, HEAVY (auto. mfg.)

Repairs heavy automobile or truck units, such as motors, transmissions, or differentials, before units are assembled into chassis, applying knowledge of mechanical systems and using handtools: Places malfunctioning unit on repair stand, using hoist. Reads inspection care which notes reason for rejecting unit. Disassembles unit and replaces or repairs parts, using mechanic's handtools and portable power tools. Route unit to testing area. May remove and repair defective units of completed automobiles or trucks. May be designated according to type of unit repaired as Differential Repairer (auto. mfg.); Motor Repairer (auto. mfg.); Transmission Repairer (auto. mfg.).

620.664-010 CONSTRUCTION-EQUIPMENT-MECHANIC HELPER (const.)

Assists Construction-Equipment Mechanic (const.) in repairing, assembling, and adjusting construction equipment, such as internal combustion engines, lighting plants, pumps, air compressors, concrete and mortar mixers, concrete vibrators, generators, pneumatic tools, and portable winches. Disassembles and assembles equipment using mechanic's handtools. Washes parts and tools with cleaning fluids, such as gasoline or naptha. Performs other duties as described under Helper (any ind.).

620.584-010 SPRING-REPAIRER HELPER, HAND (auto. ser.) spring-fitter helper; spring-maker helper, hand; tear-up worker, spring.

Disassembles defective vehicle leaf springs preparatory to repair and assembles repaired leaf springs: Removes center bolt from leaf spring and loosens clips, using handtools. Removes rivets from leaf spring, using punch press or drill. Drills hole in replacement blank for leaf spring, using drill, or punches hole in blank, using punch press. Reassembles leaves for leaf spring, fits keeper on leaves, and fastens with bolts. Records number of leaves in spring, dimensions of leaves, size of connecting bolt, and repairs made.

620.664-014 MAINTENANCE MECHANIC HELPER (const.; petrol. production; pipe lines) mechanic helper; shop-mechanic helper.

Assists Maintenance Mechanic (const.; petrol. production; pipe lines) in repairing and maintaining automotive and mechanical machinery and equipment, such as pumps, compressors, pipelaying machines, ditchdiggers, trucks, and tractors, using jacks, hoists, and handtools: Installs jacks and hoists to raise equipment. Disassembles and assembles equipment, using handtools. Cleans tools and parts with naptha, gasoline, and other cleaning compounds. Performs other duties as described under Helper (any ind.).

620.684-030 TRACTOR-MECHANIC HELPER (auto. ser.)

Assists Tractor Mechanic (auto. ser.) in repairing tractors and tractor components, using handtools: Installs jacks and hoists to raise equipment and lift dismantled assemblies. Disassembles and assembles tractor parts, using handtools. Cleans tools and parts with naptha, gasoline, or other cleaning compounds. May wash and lubricate equipment. Performs other duties as described under Helper (any ind.).

DEVELOPMENT OF TASKS FOR SURVEY

The tasks used in the survey were developed by the working committee of instructors from the institutions and the staff coordinator for the project. The committee identified seven major component areas of instructional needs in the diesel vehicle and heavy equipment field. These were: chassis and suspension, diesel engines, diesel fuel, electrical, hydraulics, power trains, and service. These component areas were analyzed to determine all the assignable job tasks a mechanic would perform in the course of maintenance and repair of diesel vehicles and diesel engines used in heavy equipment. The tasks were carefully written and reviewed by the committee in an attempt to list every possible assignable task performed by an employee. Three reviews of the tasks were made prior to organizing them into the survey format. The tasks were then prepared into survey format for each committee member to re-evaluate. This careful review provided the final list of one hundred ninety-four tasks for the survey.

DEFINITIONS OF TERMS USED IN THIS DOCUMENT

Competency is a statement of a task to be performed with a specified degree of accuracy and/or proficiency.

Criterion measure is a statement of the predetermined standard to which an employee can perform, or must be able to perform, a given task. The criterion measures are those conditions used in evaluating job performance and the performance of the completed function.

Knowledge/Theory is the theoretical information one must know in order to understand the why, how, and relationships of the function of the task, its component parts, or its purpose within a system.

Manufacturer's recommendations refers to the steps or manner in which the manufacturer has prescribed a process for servicing, repairing, overhauling, or rebuilding.

Manufacturer's specifications are the tolerances and limits as prescribed by the manufacturer of the component or assembly for use in a given manner.

Overhaul is used to denote the rebuilding and the reconditioning by machining process, welding, or other methods to specifications and the reassembling with serviceable and/or new or reconditioned components.

Rebuild is used to denote the disassembly, cleaning, checking, replacement of parts with new or reconditioned parts, reassembly, and carrying out of recommended procedures and tests to assure functioning according to manufacturer's specifications.

Recondition is used to indicate the restoring of a component or an assembly to condition equal to, or better than, the original by machining, welding, replacing components, and/or restoring with other materials or methods which are acceptable to the industry as being equal to, or better than, the original.

Repair is used to denote the action of putting back in good condition after damage using such methods as welding, reforming to original shape, or splicing and taping of wiring.

Replace is used to indicate when something is exchanged with another: generally to replace a used, damaged, or broken part with a new or undamaged part.

Secure is used to denote that all safety practices and procedures are followed and vehicle or component is in a position whereby it is safe to perform work.

Service is used to denote the periodical maintenance, such as oiling, greasing, replacing filters, cleaning, and/or adjustment of components of an engine, the total engine, or the vehicle.

Skills/Process information is an analysis of the task to identify basic skills and/or the process one must be able to perform and must know in order to perform the task.

Task area is the grouping of related tasks into a specific major segment of the job such as engines, hydraulics, chassis and suspensions, etc.

Task statements used in this document are statements of a distinct unit of work (job) that an employee would be assigned to do in the performance of the job. The tasks listed were those that could normally be independently assigned in the actual job situation.

Value/Attitude concepts are those concepts unique to the task that shape personal behavior in carrying out the task assigned in a particular manner and to a specified degree of accuracy.

SURVEY

One of the important goals of this curriculum review was to provide maximum input from as many employers, employees, and educators as feasible. In addition to a curriculum committee and a curriculum advisory committee, a mail survey of the tasks (See Appendix A) was developed and distributed to employers and employees in the diesel industry and to all diesel educators in the community colleges, technical colleges, and technical institutes offering diesel curriculums.

The survey was developed by the curriculum committee and was modeled after a survey of the same type used by James D. Howell in his dissertation, "An Identification of the Competencies in English Needed by Vocational Students in the Community Colleges and Technical Institutes in North Carolina."

The survey consisted of 194 items the curriculum committee considered as potential tasks employees in the diesel industry might perform. Each respondent was requested to rate the tasks on a scale of one to five to indicate his/her opinion of the importance of employee competency in performing the task to job performance. The scale was: (1) no competency in this activity, (2) slight competency in the activitiy, (3) moderate competency in the activity, (4) considerable competency in the activity, and (5) complete competency in the activity. Webster's definitions (Competent 1. Well qualified, capable, fit; and Competency 2. Condition or quality of being competent) were listed on the survey to provide guidance and a common reference frame.

Twenty copies of each survey were distributed to the head diesel instructor in the nine institutions offering diesel curriculums in the System. They were asked to distribute the surveys to each diesel instructor on their staff and to employers and employees in the community their curriculum served.

One hundred and eighty surveys were sent to the head instructors. Thirty-seven were returned (20.6%). There was an equal distribution of returns from employers (13), employees (12), and educators (12). While the number of returns was not very high, it was sufficient to indicate trends and to provide a basis for determining the tasks most important to the industry.

NUMBERING OF TASKS

The tasks were numbered when the survey was made. In order to accommodate the processing of the survey returns by data processing, it was necessary to provide identification information on the computer. The numbers 1-10 were left for this information and the task numbering began with number 11. Therefore, Task 11 is actually the first task. These numbers were maintained throughout the document. After the survey was completed and analyzed and during the writing of the task analyses, additional tasks were added. When these tasks represented a new area or subject a new number was given by picking up the next number after the last numbered task. In many cases when the task analyses were being written it became necessary to add additional tasks to the task being analyzed. When this was necessary the same number was given to the task with a letter suffix such as Task 158 and Task 158A.

ANALYSIS OF DATA

The information received from the survey was compiled into four ratings: (1) how the group rated each task, (2) how the employers rated each task, (3) how the employee rated each task, and (4) how the educator rated each task. The items were listed in rank order ranging from the highest total group rating to the lowest total group rating. Statistical analyses were not made to show significant differences between how each group rated each item. A complete listing of the tasks in rank order of rating from 1 (highest rating) to 194 is shown in Appendix B. This table provides information on the rank order, the task, the number of respondents, the group rating, the employer rating, the employee rating, the educators' rating, and the frequency of responses for each item in the scale for each task.

An analysis of this data indicates that the employer and the educator are in close agreement and when all tasks are combined, they each rank the importance of the task higher than the employee. This tends to indicate that both the educator and employer are desiring a higher level of performance than is actually being performed on the job. The following are six comparisons of the data which tend to support the higher level of performance desired by the employers and educators (See Table 1):

- The employers rated 161 items higher, 5 equal, and 28 lower than the group.
- The employees rated no items higher, 2 items equal, and 192 items lower than the group.
- The educators rated 163 items higher, 1 item equal, and 30 items lower than the group.
- The employers rated 192 items higher, 1 item equal, and 1 item lower than the employee.
- The employer rated 93 items higher, 5 items equal, and 96 items lower than the educator.
- The educator rated 190 items higher and 4 items lower than the employee.

Table 1

Comparison of Rating of Total Items Between Each Group

	Total Items	Items Rated Higher	Items Rated Equal	Items Rated Lower
Group versus employers	194	28	5	161
Group versus employees	194	192	2	0
Group versus educators	194	30	1	163
Employer versus employee	194	192	1	1
Employer versus educator	194	93	5	96
Employee versus educator	194	4	0	190

HOW DATA WAS USED

The intent in making the survey was to provide employer-employee input into the curriculum development process and to be able to compare the relationship between industry and education views. The survey data provides a means of comparing the importance that each group attaches to each task. The ratings of the group were compared with the rankings of the employers, employees, and educators to see if there was agreement or a difference as to how each rated the importance of the item. Where there was a difference the committee attempted to determine the reason for the difference and to make allowances for this in the analysis. Items ranked very low by the group were carefully screened by the committee and were withdrawn unless they were basic to another task.

The educators on the committee were given the prerogative to decide which tasks should be maintained in the curriculum, the emphasis to be placed on each task competency, and the order in which the tasks would be suggested to be taught in the curriculum. The educators also determined the need to consolidate some of the tasks after the survey was made. Some of the tasks were eliminated when the competencies were written since the basic task was an essential part of a major task. Some of the questionnaires returned included comments and suggested additional tasks. The comments were carefully considered by the committee completing the writing of the materials and the tasks were reviewed to assure that each comment was appropriately included in the task analysis. Three additional tasks were accepted from the suggested list to be included in the curriculum.

ADDITIONAL TASKS SUGGESTED ON SURVEY RETURNS

The following is a list of tasks suggested by the respondents on the survey. No attempt has been made to rewrite these items into a task statement to conform to the original task listing format. Three tasks, Numbers 19, 20, and 31, were selected to be added to the list of tasks by the committee. Each of the remaining statements was carefully screened and found to be included in an existing task as each task analysis was completed.

1. Troubleshoot
2. Ordering parts
3. Analyze problem before making decision
4. Inspecting work after job is completed
5. Use proper tools
6. Measure fuel API gravity with thermo-hydrometer. This sometimes saves hours on troubleshooting "low power" complaint
7. Check "full load" rpm, or governor balance point on Caterpillar engines. Correct full load speed has priority over published high idle specifications
8. Check for correct operation of variable displacement piston-type pump. This type hydraulic pump is used on several lines of Caterpillar products
9. Parts failure diagnosis: gears, pump, engine parts
10. Hydraulic variable capacity piston pumps
11. Welding and gas cutting
12. Written communication
13. Reading hydraulic schematics
14. Read micrometers, dial indicators, and calipers
15. Knowledge of pump flow and leakage
16. Drill and tap holes
17. Proper use of tools: electric, air
18. Be able to read and understand shop manuals
19. How to run in a new or rebuilt motor
20. How to test engine with dynamometer
21. How to properly weigh tractors for best performance
22. To know the limits of a machine
23. Stress cleanliness while doing all repairs
24. Safety
25. On-the-job training while in school
26. Proper use and storage of micrometers and other similar tools
27. Know how to operate engine and chassis dynamometer
28. Know all parts on a truck, how they operate and why
29. Be able to adjust and repair various types of clocks used to measure speeds such as wagner or tachograph
30. Troubeshoot and make sound decisions
31. Be able to drive a tractor and trailer for road test. Sometimes this is needed to determine the trouble
32. Under carriage wear
33. Remove and replace alignment
34. Understand front end caster and camber

COMMENTS ON SURVEY RETURNS

The following comments were made by the survey respondents. They were carefully reviewed and considered by the committee as the tasks were analyzed.

1. Decision for reuse of certain items would not be the responsibility of the mechanic. In our operation this responsibility rests with the shop foreman. (Refers to Tasks 168 & 193.)
2. I was once a diesel and gas student myself. Please let them know that going into a company as a new employee, you might have

to start on a lower pay scale and most likely night work.
Thank you for this opportunity

3. It appears to me you are combining several curriculums in one. If we expect any students to learn and perform each of these tasks, we will need to change our curriculum from 6 quarters to 12-16 quarters
4. Normally, not part of a mechanic's duties (Refers to Task 55)

METHODOLOGY USED IN THE PROJECT

This curriculum project identified the competencies necessary for successful employment in diesel vehicle occupations in response to concerns that diesel curricula in the System provide:

1. A quality of instruction which makes it possible for individuals completing a curriculum or phase of a curriculum to be prepared for employment;
2. Articulation between secondary and post-secondary vocational-technical curriculums;
3. Involvement of employers, employees, and educators in curriculum development; and
4. Assurance that curricula are up-to-date in accordance with current job technology requirements.

In response to these concerns the project provided (1) a validated list of career (job) opportunities for which each curriculum provides training and education; (2) the tasks performed by employees in each job; and (3) a list of competencies and evaluative criteria essential to successfully perform in the job.

The procedure for conducting this project was accomplished in four phases:

Phase I of the project identified the curricula for which competencies were to be developed. Diesel curricula currently offered in the Community College System included were: T-003 Diesel and Equipment Technology, V-013 Diesel Vehicle Maintenance, and V-026 Heavy Equipment Mechanics (Earthmoving).

Phase II of the project was a search for existing competency-based curriculum materials. These materials were used as resources in writing the materials herein.

Phase III of the project identified and validated the career opportunities (job titles) currently used by the diesel industry. The career opportunities were identified from the Dictionary of Occupational Titles.

A job analysis was made to determine the tasks the person performs in carrying out the function of the job. The tasks were validated by surveying employers, employees, and educators.

Phase IV of the project analyzed each task to determine the skill or skills needed, the technical knowledge needed, and the attitudes/values necessary for functioning successfully in the job. From the task analysis, competencies were written with criterion for measuring performance.

Each phase of the project was designed to assure maximum involvement in the developmental process. In order to assure involvement a curriculum committee was appointed.

The curriculum committee was composed of teachers from the Community College System. The presidents of the institutions in the Community College System offering diesel curriculums nominated persons from their institutions to serve on the curriculum committee. This committee was a working committee and was responsible for writing and preparing all materials including the job title survey, task inventory survey, task analysis and competencies.

METHOD OF USING TASK ANALYSIS

The task analyses are designed so the instructor can use them to determine how to teach each task, when to teach a task, and to some degree the amount of emphasis placed on each task. Each institution should very carefully review each of the task analyses and the survey data. They should then involve an active advisory committee of employers and employees from the area the institution serves to advise them in planning the curriculum. The advisory committee can give advice on organization and emphasis to be placed on a task and can help to decide on the hierarchical order of importance for teaching each task. The instructors should determine the courses to be taught, the sequence and length of the courses and which tasks are to be taught in each course. The knowledge/theory can be used to prepare the basic outline of theory to be taught when the decision has been made in which course each task will be taught.

TASK ANALYSIS

The task analysis provides to the educator the information needed to determine what is to be taught and the level of skill necessary to function effectively on the job. Each task confirmed by the survey as being necessary for the employee to perform was analyzed to identify the competency required, the criterion of satisfactory performance, the skills or process the employee must have or follow in performing the task, the knowledge or theory one must know to effectively perform the task and attitudes and values needed to be successful in carrying out the task assigned.

COMPETENCIES

Each task was restated as a competency statement. The competency statement defines the degree of accuracy and/or proficiency the employee should attain in performing the assigned task. The competencies, as well as the tasks, are written to reflect the level of performance necessary for the employee to be successful on the job. The employee should be able to perform the task at the competency level as measured by the criterion.

CRITERION

The criterions for each competency were stated as a measure of what the employee can do in carrying out the assigned task to the level of competency stated. These criterions are used to judge success or degree of accuracy to which the assigned task is performed. These were written to reflect the critical performance standards for the competency.

SKILL/PROCESS

The skill/process provides the basic steps and skills the employee must perform in order to do the task at the level of competency. Each person must be able to perform each skill/process in order to effectively complete the task as assigned at a level of proficiency acceptable by the industry. The skill/process statements or steps may also be considered as sub-tasks. These sub-tasks may be assignable jobs to be carried out in the employing operation or in the teaching/learning setting.

KNOWLEDGE/THEORY

The knowledge/theory is outlined to provide the basic principles and concepts an employee needs to be successful in the employing world. It is essential information the employee needs to know in order to understand the why, how, and relationships of the function of the task, its component parts, or its purpose within the system. The knowledge/theory should be an integral part of the instructional program to assure that the person has the foundation to build skills and to keep those skills current.

VALUE/ATTITUDE

The value/attitude concepts are those concepts unique to the task that shape personal behavior in carrying out the task assigned in a particular manner and to a specified degree of accuracy. There are many attitudes and values that should be included throughout the curriculum. Those value/attitudes that should be continuously stressed are not repeated from task to task. These value attitudes are:

Shop cleanliness
Safety
Cooperativeness with co-workers and customers
Respect for others
Respect for customer
Customer satisfaction
Craftsmanship
Pride in workmanship
Shop and equipment care and maintenance
Productivity
Care of customer equipment

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Component Areas					
chassis and suspension	#67 SERVICES WHEEL BEARINGS & SEALS	#68 INSTALLS AND TRUES TIRE AND RIM ASSEMBLY ON SPOKE WHEELS	#69 CHECKS STEERING LINKAGE	#70 REBUILDS STEERING SECTOR BOX	#71 ADJU SECTOR S
	#81 REMOVES AND REPLACES TORQUE ARM BUSHINGS	#85 REBUSHS WALKING (EQUALIZING) BEAM	#86 ALIGNS REAR AXLE ASSEMBLY	#87 REPAIR FIFTH WHEEL	#88 TEST SYSTEM
	#98 REBUILDS HYDRAULIC BRAKE MASTER CYLINDER	#99 REBUILDS HYDRAULIC SLAVE (WHEEL) CYLINDER	#100 REMOVES AND REPLACES POWER BRAKE UNIT	#101 BALANCES TIRES	#103 REPA OR ADJUST RELIEF V
diesel engines	#162 DISASSEMBLES ENGINE, CLEANS COMPONENTS TO MAKE PARTS READY FOR INSPECTION	#163 INSPECTS BLOCK BORES AND SURFACES AND MAKES DECISION ON REPAIRS	#164 REPAIRS BLOCK BORES AND SURFACES	#165 INSPECTS BLOCK MACHINE WORK & INSTALLS CAM BEARINGS, CORE & GALLERY PLUGS	#166 INS LINER AND ON REUSE
	#176 REMOVES, INSPECTS, & INSTALLS BALANCER SHAFTS	#176A REMOVES, INSPECTS, & INSTALLS VIBRATION DAMPERS	#177 INSPECTS FLYWHEEL FOR WEAR, CRACKS & RING-GEAR CONDITION & MAKES DECISION ON REPAIRS	#178 INSPECTS, REPAIRS, & INSTALLS FLYWHEEL HOUSING & INSTALLS HOUSING CENTERED TO CRANKSHAFT	#179 IN WORK ON FLYWHEEL, GEAR, HOU CHECKS F
	#187 INSPECTS GEAR COVERS, PANS & SUMPS FOR CRACKS & MOUNTING SURFACES FOR WARPAGE	#188 MAKES REPAIRS TO DAMAGED DRAIN PLUG THREADS	#189 INSTALLS ENGINE SEALS	#190 REBUILDS & INSTALLS OIL PUMP	#191 IN REBUILDS WATER PU
diesel fuel	#155 REBUILDS AND CALIBRATES FUEL INJECTION PUMPS	#156 REBUILDS FUEL SUPPLY PUMP	#158 REBUILDS AND TESTS GOVERNOR	#158A TESTS AND ADJUSTS GOVERNOR ON ENGINE IN VEHICLE	#159 RE AIR FUEL
electrical	#45 REPLACES OR REPAIRS BATTERY CABLES OR CABLE ENDS	#46 REPAIRS ELECTRIC STARTER MOTOR	#47 PERFORMS STARTER AMPERE-DRAW TEST ON VEHICLE	#48 REMOVES AND REPLACES STARTER MOTOR	#49 REPA
	#58 REMOVES AND REPLACES ALTERNATOR	#59 REBUILDS ALTERNATOR	#60 TESTS AND ADJUSTS ALTERNATOR VOLTAGE REGULATOR ON VEHICLE	#61 REPAIRS AND TESTS ALTERNATOR VOLTAGE REGULATOR	#61A RE TRANSIST REGULATO
hydraulics	#11 CONSTRUCTS HIGH PRESSURE HYDRAULIC FLEX LINES	#12 CONSTRUCTS, FLARES, & BENDS METAL HYDRAULIC TUBING	#13 INSTALLS HYDRAULIC LINES	#14 CHECKS HYDRAULIC PUMP PRESSURE, FLOW, & VISCOSITY	#15 REM HYDRAULI
	#26 TEST HYDRAULIC SYSTEMS FOR LEAKS (INTERNAL-EXTERNAL)	#104 CLEANS AND BLOWS OUT FINS ON OIL COOLER	#105 REMOVES FROM HOUSING AND PRESSURE TESTS OIL COOLERS	#106 REPLACES GASKETS & SEALS & REASSEMBLES OIL COOLERS IN HOUSING	#107 RE HYDRAULI
power trains	#110 REMOVES & REINSTALLS TRANSMISSION	#111 REMOVES & REPLACES SINGLE PLATE CLUTCH (TRANSMISSION REMOVED)	#112 REMOVES & REPLACES TWO-PLATE CLUTCH (TRANSMISSION REMOVED)	#113 REPLACES FLYWHEEL DRIVE LUGS FOR TWO-PLATE CLUTCH	#114 AL FLYWHEEL
	#124 OVERHAULS THREE COUNTERSHAFT TRANSMISSION	#125 REPLACES TRANSMISSION INPUT SHAFT SEPARATE FROM TRANSMISSION OVERHAUL	#126 REPLACES SPEEDOMETER DRIVE GEAR SEPARATE FROM TRANSMISSION OVERHAUL	#127 REMOVES & REPLACES SHIFT LEVER HOUSING FROM TRANSMISSION SEPARATE FROM TRANS. OVERHAUL	#128 RE LEVER H
	#138 REMOVES & REPLACES DRIVELINE CENTER BEARINGS	#139 REMOVES & REPLACES REAR DIFFERENTIAL CARRIER ASSEMBLY IN TANDEM	#140 REBUILDS REAR DIFFERENTIAL CARRIER ASSEMBLY	#141 REMOVES & REINSTALLS FRONT DIFFERENTIAL CARRIER ASSEMBLY IN TANDEM	#142 RE DIFFERE ASSEMBLY
	#1[illegible]4 REBUILDS POWER TAKE-OFF				
service	#27 CHANGES ENGINE OIL	#28 CHANGES ENGINE OIL FILTERS	#29 CHANGES ENGINE FUEL FILTERS	#30 SERVICES ENGINE WATER FILTERS	#31 SERV
	#42 PERFORMS VEHICLE SAFETY INSPECTION	#43 SERVICES & REPAIRS CAB HEATING & AIR CONDITIONING SYSTEM	#44 SERVICES COOLING SYSTEM	#194A SERVICE TURBOCHARGER	#207 DRIV TRAILER

Diesel Vehicle Maintenance

—JOB PERFORMANCE TASKS—

Department of Community Colleges
Occupational Program Services
Raleigh, NC

STEERING N VEHICLE	#72 REPAIRS AND/OR ADJUSTS DRAG LINK	#73 REMOVES, REPLACES, OR REPAIRS TIE-RODS	#74 REMOVES & REPLACES STEERING SHAFT AND BEARINGS	#75 REMOVES & REPLACES STEERING KNUCKLE BALL JOINT	#76 ALIGNS FRONT END	#77 REMOVES & REPLACES KING PIN AND BUSHINGS	#78 REMOVES & REPLACES FRONT AXLE	#79 REMOVES AND REPLACES SPRINGS	#80 REPAIRS OR REBUILDS SPRING ASSEMBLY AND SHACKLES, HANGERS, & PADS
R BRAKE	#89/102 REMOVES AND REPLACES VARIOUS AIR SYSTEM COMPONENTS. SERVICES AIR BRAKE SYSTEM PLUMBING	#90 REMOVES & REPLACES SERVICE BRAKE CHAMBER DIAPHRAGM	#91 REMOVES AND REPLACES BRAKE SHOES	#92 RELINES BRAKE SHOES	#93 OVERHAULS AIR BRAKE ACTUATOR ASSEMBLIES	#94 REMOVES & REPLACES SPRING BRAKES CHAMBERS	#95 REPAIRS OR REBUILDS SPRING BRAKES	#96 REMOVES, REPLACES, AND ADJUSTS AIR GOVERNOR	#97 ADJUSTS BRAKES
, REPLACES, AIR PRESSURE									
TS CYLINDER AKES DECISION	#167 RECONDITIONS CYLINDER LINER BY BORING AND/OR HONING	#168 INSPECTS PISTONS AND MAKES DECISION ON REUSE	#169 REPAIRS PISTON SKIRTS, RING GROOVES, AND PIN BORES	#170 INSPECTS CONNECTING RODS AND MAKES DECISION ON REUSE	#171 RECONDITIONS CONNECTING ROD BORES, REPAIRS SLIGHT BENDS & TWISTS	#172 INSPECT CRANKSHAFT FOR CRACKS, WEAR, & STRAIGHTNESS & MAKES DECISION FOR RECONDITIONING WORK	#173 INSPECTS MACHINE WORK ON RECONDITIONED CRANKSHAFT	#174 INSTALLS BEARINGS, CRANKSHAFT, PISTON COOLERS LINERS, RINGS, PISTON, & RODS FITTING ALL COMPONENTS TO MANUFACTURER'S SPECIFICATIONS	#175 MAKES INFRAME INSPECTION OF BEARING WEAR & INSTALLS NEW BEARINGS
TS MACHINE DITIONED STALLS RING S FLYWHEEL & UT	#180 INSPECTS CAMSHAFT FOR CRACKS, WEAR & WARPAGE & MAKES DECISION ON MACHINE WORK	#181 INSPECTS MACHINE WORK ON RECONDITIONED CAMSHAFTS, INSTALLS CAMSHAFTS & ADJUSTS END PLAY TO MFG.'S SPECIFICATIONS	#182 INSPECTS GEAR TRAIN, CHECKS BACKLASH AND ALIGNS TIMING MARKS	#183 INSPECTS LIFTERS OR FOLLOWERS FOR WEAR AND CRACKS; REPLACES PINS, BUSHINGS, ROLLERS; INSTALLS LIFTER ASSEMBLIES; AND INSPECTS PUSH RODS AND MAKES DECISION ON REUSE		#184 INSPECTS ROCKER ARMS & SHAFTS FOR CRACKS & WEAR, RECONDITIONS WORN SURFACES, REPLACES SHAFT BUSHINGS & INSTALLS ASSEMBLY TO HEAD	#185 INSPECTS CYLINDER HEAD ASSEMB. & MAKES DECISION ON REPAIRS & RECOND. TO REBUILD THE HEAD TO MFG.'S SPECS.	#186 INSPECTS MANIFOLDS FOR CRACKS AND MOUNTING SURFACE FOR WARPAGE; INSTALLS NEW WATER, INTAKE AND EXHAUST MANIFOLD GASKETS; AND INSTALLS THERMOSTATS & SEAL IN WATER MANIFOLD.	
S, REMOVES, D INSTALLS	#192 REMOVES OIL COOLER CORE & TESTS; INSPECTS HOUSING & REASSEMBLES OIL COOLER	#193 INSPECTS BLOWER, MAKES DECISION ON REPAIRS INSTALLS REBUILD KIT, MAKES CLEARANCE ADJUSTMENT	#194 REBUILD TURBOCHARGER	#195 REMOVES ACCESSORY DRIVE, REPLACES BEARING, INSTALLS ACCESSORY DRIVE & SEALS, AND MAKES NECESSARY ADJUSTMENTS	#196 MAKES TEST AND DETERMINES BEST MEANS FOR REPAIRING RADIATORS	#205/206 RUN IN NEW OR REBUILT DIESEL ENGINE. TEST ENGINE WITH DYNAMOMETER			
S AND TESTS TIO VALVES	#160 TESTS FUEL INJECTIONS AND NOZZLES	#161 REBUILDS & TESTS FUEL INJECTOR & NOZZLES	#197/198 REMOVES AND INSTALLS FUEL INJECTORS OR NOZZLES, INSTALLS INJECTION FUEL PUMP & NOZZLES OR INJECTORS; MAKES STATIC SETTING TO FUEL SYSTEM & COLD VALVE ADJUSTMENT		#199/204 CHECKS FUEL MANIFOLD PRESSURE AND/OR TIMING, & CHECKS AIR FLOW RESTRICT. & BOOST PRESSURE. TESTS INTAKE MANIFOLD PRESSURE	#200 REMOVES & INSTALLS HIGH PRESSURE FUEL LINES	#201/157 REMOVES AND INSTALLS INJECTION PUMP. INSPECTS, CLEANS, & LUBRICATES FUEL PUMP SUB-ASSEMBLY	#202 REMOVES & INSTALLS FUEL SUPPLY PUMPS	#203 CHECKS AND ADJUSTS ENGINE GOVERNOR HIGH & LOW IDLE SETTING
OLENOID UNIT	#50 REPAIRS SERIES-PARALLEL SOLENOID UNIT	#51 SERVICES AIR STARTER MOTOR	#51A REBUILDS AIR STARTER MOTOR	#52 TESTS D. C. GENERATORS ON VEHICLE	#53 REMOVES & REPLACES D. C. GENERATOR	#54 REBUILDS D. C. GENERATOR	#55 TESTS AND ADJUSTS D. C. REGULATORS	#56 REMOVES & REPLACES D. C. REGULATOR	#57 TESTS ALTERNATOR ON VEHICLE
S AND TESTS VOLTAGE	#62 REMOVES & REPLACES ELECTRICAL RELAY	#63 REMOVES, REPLACES, OR REPAIRS TURN SIGNAL UNIT	#64 REWIRES "7" WAY TR[illegible] PLUG & CORD	#65 REMOVES & REPLACES DASH SWITCHES & GAUGES	#66 TROUBLESHOOTS AND REPAIRS ELECTRICAL LIGHTING SYSTEMS				
& REPLACES PP	#16/17 DISASSEMBLES AND CHECKS HYDRAULIC PUMP. REASSEMBLES & INSTALLS CARTRIDGE KIT IN HYDRAULIC PUMPS	#18 CLEANS & PURGES HYDRAULIC SYSTEM	#19 REPLACES HYDRAULIC FILTERS	#20 RUNS HYDRAULIC SYSTEM AND CHECKS OIL LEVEL	#21 VISUALLY CHECKS HYDRAULIC SYSTEM FOR DAMAGE	#22 CHECKS AND ADJUSTS HYDRAULIC COMPONENT MOUNTING & ALIGNMENT	#23 REMOVES AND REPLACES HYDRAULIC CYLINDERS	#24 STRAIGHTENS & POLISHES HYDRAULIC CYLINDER SHAFT	#25 REPAIRS OR REBUILDS HYDRAULIC CYLINDERS
S AND ADJUSTS CCUMULATORS	#108 SERVICES HYDRAULIC CONTROL VALVE BODIES	#109 REBUILDS HYDRAULIC CLUTCH MASTER CYLINDER							
ENGINE USING	#115 DISASSEMBLES AND REBUILDS PRESSURE PLATE	#116 RELINES CLUTCH DISC	#117 REMOVES & REPLACES CLUTCH RELEASE BEARING	#118 REPLACES PILOT BEARING	#119 REBUILDS 4- OR 5-SPEED MANUAL TRANSMISSION FOR MEDIUM DUTY TRUCK	#120 REBUILDS AUXILIARY TRANSMISSION	#121 REMOVES & REPLACES TRANSMISSION AIR SHIFT MECHANISMS	#122 REBUILDS AIR SHIFT MECHANISM	#123 OVERHAULS THIN COUNTERSHAFT TRANSMISSION
D SHIFT NG	#129 REMOVES & REPLACES REMOTE SHIFTER	#130 REPAIRS REMOTE SHIFTER	#131 REMOVES AND REPLACES AUTOMATIC TRANSMISSION	#132 REBUILDS AUTOMATIC AND/OR POWER SHIFT TRANSMISSION	#133 REBUILDS TORQUE CONVERTER (NON-SEALED UNITS)	#134 REMOVES AND REINSTALLS DRIVELINE	#135 SETS ANGULARITY OF DRIVE LINE	#136 REMOVES & REPLACES UNIVERSAL JOINTS	#137 REMOVES & REPLACES YOKE (DRIVE-LINE REMOVED)
S FRONT L CARRIER	#143 REMOVES AND REINSTALLS INTER-AXLE DIFFERENTIAL	#144 REBUILDS INTER-AXLE DIFFERENTIAL	#145 REBUILDS LIMITED SLIP DIFFERENTIAL	#146 REPLACES PINION SEAL SEPARATE FROM CARRIER OVERHAUL	#147 REMOVES AND REINSTALLS TWO-SPEED SHIFT UNIT	#148 REBUILDS TWO-SPEED SHIFT UNIT	#149 REMOVES AND REINSTALLS FRONT DRIVE AXLE TRANSFER CASE	#150 REBUILDS TRANSFER CASE	#153 REMOVES & REINSTALLS POWER TAKE-OFF UNIT
AIR FILTERS	#32 LUBRICATES VEHICLE	#33 SERVICES GEAR BOX OIL FOR LEVEL OR NEED TO CHANGE	#34 SERVICES RADIATOR SHUTTER SYSTEM	#35 CHECKS AND INFLATES TIRES	#37 SERVICES AND TESTS BATTERIES	#38 REPAIRS EXHAUST SYSTEM	#39 INSPECTS AND ADJUSTS BELTS	#40 SERVICES VEHICLE LIGHTING SYSTEM	#41 SERVICES WINDSHIELD WIPER SYSTEM (AIR & ELECTRIC)
ACTOR D TEST									

TASK AREA: Hydraulics

TASK #11: Constructs high pressure hydraulic flex lines.

COMPETENCY: Cut and fabricate a high pressure hydraulic flex line according to manufacturer's specifications for the equipment being repaired.

CRITERION: Can select the correct hydraulic line material and fitting for pressure rating according to manufacturer's specifications.

Can cut line to correct specified length.

Can assemble line with fittings to assure no leaks and that the line will function under correct pressure rating.

SKILL/PROCESS:

1. Select correct hydraulic line material and fittings
2. Cut line to correct specified length
3. Install fittings on flex line and test for leaks

KNOWLEDGE/THEORY:

1. Principles of hydraulics
   a. Pressure
   b. Flow
   c. Fluid types
2. Hydraulic tubing construction
   a. Material
   b. Strength
   c. Length
   d. Fitting types
      (1) Replaceable
      (2) Crimp on
      (3) JIC
      (4) SAE
3. Techniques of line construction
   a. Cut with hacksaw
   b. Cut with machine
   c. Installation tools for replaceable fittings
   d. Crimping tools

VALUE/ATTITUDE CONCEPTS: Understands importance of correct pressure ratings.

Understands importance of correctly matching fittings.

TASK AREA: Hydraulics

TASK #12: Constructs, flares, and bends metal hydraulic tubing.

COMPETENCY: Cut to correct length, flare, and bend hydraulic tubing according to manufacturer's specifications.

CRITERION: Can select metal hydraulic tubing which meets test requirements set by manufacturer's specifications for equipment being repaired.

Can bend metal hydraulic tubing to specified bend radius.

Can bend metal hydraulic tubing properly to follow routing path with proper clearance around obstructions.

SKILL/PROCESS:

1. Select hydraulic tubing and connections that meet manufacturer's specifications
2. Measure and cut tubing to correct length
3. Assemble fittings to lines and flares
4. Bend tubing for correct installation on equipment being repaired

KNOWLEDGE/THEORY:

1. Principles of hydraulics
    a. Pressure
    b. Flow
    c. Fluid types
2. Hydraulic tubing construction
    a. Material
    b. Strength
    c. Length
    d. Fittings
3. Construction techniques
    a. Tubing cutter
    b. Double flare
    c. Single flare
    d. Tubing and pipe bending tools
    e. Fittings (SAE, JIC)

VALUE/ATTITUDE CONCEPTS: Understands importance of proper bending.

Understands importance of matching fittings correctly.

TASK AREA: Hydraulics

TASK #13: Installs hydraulic lines.

COMPETENCY: Remove and install flex and metal hydraulic lines and secure with clamping devices.

CRITERION: Can bend lines to meet manufacturer's specifications covering bend radius and working pressure test.

Can route lines according to manufacturer's specifications allowing for proper clearances.

Can secure lines according to manufacturer's specifications.

SKILL/PROCESS:

1. Clean area around line connections to prevent entry of dirt into system
2. Remove clamps and hydraulic line
3. Bend steel line for proper routing to fit vehicle
4. Route line as necessary to clear obstructions and prevent chafing
5. Fasten connections and tighten to assure no leakage
6. Clamp lines to prevent vibration

KNOWLEDGE/THEORY:

1. Function of lines
    a. Transfer hydraulic fluids under pressure
    b. Pressure ratings
2. Types of lines
    a. Metal-rigid
    b. Flexible
3. Construction
    a. Flexible
        (1) Fabric braided
        (2) Single wire braided
        (3) Double wire braided
        (4) Spiral
    b. Rigid-steel
    c. Hose couplers and fittings
        (1) Threaded seal
        (2) Dry seal
        (3) Flare seal
        (4) O-ring seal
        (5) Split flange
    d. Rigid couplers and fittings
        (1) Flared fitting
        (2) Flareless fitting
4. Installation
    a. Bend radius
    b. Taut
    c. Twist
    d. Loop
    e. Clamping and securing

5. Hose failure
    a. Cracking or splitting
    b. Pin hole leaks
    c. Improper length
    d. Rubbing wear
    e. Heat damage
    f. Pressure rating
6. Routing
    a. Bends
    b. Expansion and contraction
    c. Supports
    d. Vibration

VALUE/ATTITUDE CONCEPTS: Understands importance of proper installation to prevent damage.

TASK AREA: Hydraulics

TASK #14: Checks hydraulic pump pressure, flow, and viscosity.

COMPETENCY: Install flow meter and pressure gauge at correct pressure points to determine flow and pressure.

CRITERION: Can record and compare hydraulic pump volumetric delivery and rated pressure to determine if manufacturer's specifications are met.

Can check viscosity of oil using viscosity meter and compare to specifications to determine whether oil is the proper viscosity.

SKILL/PROCESS:

1. Install flow meter and pressure gauge at the proper test points
2. Start vehicle and warm oil to operating temperature
3. Operate test equipment and record flow and pressure readings
4. Compare readings with manufacturer's specifications
5. Take oil sample from machine and test viscosity
6. Compare viscosity with manufacturer's specifications

KNOWLEDGE/THEORY:

1. Definitions
   a. Pressure
   b. Flow
   c. Viscosity
2. Instruments for measuring
   a. Pressure - gauge
   b. Flow - flow meter
   c. Viscosity - viscometer
3. Hydraulic testers
4. Purpose of hydraulic pump
   a. Provide flow of hydraulic fluid
   b. Gain mechanical advantage
   c. Transfer power
   d. Advantages

VALUE/ATTITUDE CONCEPTS: Understands why pressure, flow, and viscosity are critical to proper operation of pumps.

TASK AREA: Hydraulics

TASK #15: Removes and replaces hydraulic pump.

COMPETENCY: Remove damaged pump and replace with new or rebuilt pump and then adjust and perform test to assure pump is operating according to manufacturer's specifications.

CRITERION: Can remove and install pump according to manufacturer's specifications.

Can check to determine if pump delivers the correct pressure and flow.

SKILL/PROCESS:

1. Clean exterior of pump and lines and remove pump following manufacturer's recommended procedure
2. Install new or rebuilt pump and check for leaks
3. Check pump for correct pressure and flow

KNOWLEDGE/THEORY:

1. Definitions
    a. Pressure
    b. Flow
    c. Viscosity
2. Instruments for measuring
    a. Pressure - gauge
    b. Flow - flow meter
    c. Viscosity - viscometer
3. Hydraulic testers
4. Purpose of hydraulic pump
    a. Provide flow of hydraulic fluid
    b. Gain mechanical advantage
    c. Transfer power
    d. Advantages
5. Cleaning
    a. External
    b. Mating surfaces
    c. Internal

VALUE/ATTITUDE CONCEPTS: Understands importance of proper installation and critical nature of cleanliness.

TASK AREA: Hydraulics

TASK #16: Disassembles and checks hydraulic pump.

TASK #17: Reassembles and installs cartridge kit in hydraulic pumps.

COMPETENCY: Disassemble and inspect all internal parts of the hydraulic pump and determine if parts are serviceable and reassemble making necessary repairs to assure pump will perform to manufacturer's specifications.

CRITERION: Can disassemble pump following correct procedures and avoiding damage to parts.

Can visually and with proper instruments determine wear or damage to parts and possible cause of damage.

Can make recommendations on parts to be replaced.

Can install correct cartridge repair kit in hydraulic pump and reassemble pump.

Can check hydraulic pump after reassembly to assure pump operates according to specifications.

SKILL/PROCESS:

1. Disassemble and clean pump according to recommended procedure and using proper cleaning agent
2. Inspect visually all parts for serviceability
3. Measure for wear
4. Install cartridge repair kit and reassemble pump using serviceable parts
5. Test pump to confirm pump will perform to manufacturer's specifications

KNOWLEDGE/THEORY:

1. Definitions
    a. Pressure
    b. Flow
    c. Viscosity
2. Instruments for measuring
    a. Pressure - gauge
    b. Flow - flow meter
    c. Viscosity - viscometer
3. Hydraulic testers
4. Purpose of hydraulic pump
    a. Provide flow of hydraulic fluid
    b. Gain mechanical advantage
    c. Transfer power
    d. Advantages
5. Cleaning
    a. External
    b. Mating surfaces
    c. Internal
6. Measurement checks
    a. End plate clearance
    b. Gear to gear
    c. Gear to end plate
    d. Bushing and shaft

VALUE/ATTITUDE CONCEPTS: Understands importance of cleanliness and precision fits in repair of pump.

TASK AREA: Hydraulics

TASK #18 Cleans and purges hydraulic system.

COMPETENCY: Clean and service hydraulic system with correct oils and filters.

CRITERION: Can set up equipment and hydraulic system for cleaning and flushing.

Can select and use correct flushing agents and hydraulic fluids for refilling system.

Can purge all air and foreign matter from system.

SKILL/PROCESS:

1. Clean exterior of hydraulic system and set up equipment for flushing
2. Select flushing agents and hydraulic fluids for refilling
3. Fill system with flushing agent and run machine to flush system
4. Drain system and refill with hydraulic oil
5. Run system to purge flushing agent
6. Drain remaining flushing agent and hydraulic oil
7. Refill system with hydraulic oil and run machine to purge oil
8. Check system for external leaks and proper operation of all functions

KNOWLEDGE/THEORY:

1. Purging system
    a. Remove contaminants
    b. Remove air (cavitation)
    c. Oxidized fluids
2. Flushing and cleaning
    a. Hydraulic fluid used
    b. Replacing filters
    c. Cleaning parts
    d. Protecting surfaces of cleaned parts
3. Filling the system
    a. Use recommended oil
    b. Running through operating cycle
    c. Test for operating smoothness
    d. Leak checks
    e. Level of oil fill

VALUE/ATTITUDE CONCEPTS: Understands factors that affect hydraulic oil and appreciates need to purge system of contaminants.

TASK AREA: Hydraulics

TASK #19: Replaces hydraulic filters.

COMPETENCY: Select, install filters correctly, and check to assure system does not leak.

CRITERION: Can select filters to comply with manufacturer's specifications.

Can install filters to assure correct oil flow and smooth operation.

Can check system and correct leaks.

Can check and refill system for proper oil level.

SKILL/PROCESS:

1. Clean filter housing exterior
2. Remove filters, gaskets and seals and clean filter cam
3. Select filters to comply with factory specifications
4. Install filter to assure correct oil flow and smooth operation
5. Refill system and check for leaks and proper oil level

KNOWLEDGE/THEORY:

1. Filtering
   a. Clean oils of contaminants
      (1) Water
      (2) Metal
      (3) Dirt
   b. Degrees of filtration (micron rating)
2. Types of filters
   a. Pleated paper
   b. Cotton waste
   c. Wire mesh
   d. Surface filters
3. Filter operation
   a. Full-flow system
   b. Bypass system

VALUE/ATTITUDE CONCEPTS: Understands importance of effect filters have on proper operation of system.

TASK AREA: Hydraulics

TASK #20: Runs hydraulic system and checks oil level.

COMPETENCY: Run hydraulic system to verify if system is operating properly and check to determine correct oil level.

CRITERION: Can run system to eliminate air and make necessary corrections to assure smooth operation.

Can check oil levels and refill to proper levels.

SKILL/PROCESS:

1. Start machine and warm oil to operating temperature
2. Cycle all functions to purge air and observe operating characteristics
3. Check oil level and refill with oil meeting machine manufacturer's specifications

KNOWLEDGE/THEORY:

1. System operation characteristics
   a. Condition of oil
      (1) Bubbles
      (2) Foaming
      (3) Milky oil
   b. Smoothness of operation
2. Checking oil
   a. Run engine
   b. Prevent contamination when checking

VALUE/ATTITUDE CONCEPTS: Understands effects of oil level on system.

TASK AREA: Hydraulics

TASK #21: Visually checks hydraulic system for damage.

COMPETENCY: Visually check hydraulic system for alignment and mounting and for system damage and leaks.

CRITERION: Can visually identify when system is running smoothly and identify damage that causes erratic operation.

Can visually identify alignment problems.

Can visually identify damage to mounting system, lines, and belts and check for leakage.

SKILL/PROCESS:

1. Run machine and allow oil to reach operating temperature
2. Operate all functions to determine if system operates smoothly
3. Make visual inspection for damage that could cause erratic operation
4. Make visual inspection to determine if parts are misaligned
5. Inspect bolts, nuts, pins, hoses, tubing, bearings, bushings, and other miscellaneous parts for damage

KNOWLEDGE/THEORY:

1. Mounting alignment
    a. Radial run-out
    b. Belt and pulley alignment
    c. Gear alignment and clearances
2. Adjustments
    a. Belt tension
    b. Gear clearances
3. Checks
    a. Tension gauge
    b. Dial indicator
    c. Feeler gauge
    d. Straightedge
    e. Visual

VALUE/ATTITUDE CONCEPTS: Understands and appreciates how visual checks aid in maintenance and damage prevention.

TASK AREA: Hydraulics

TASK #22: Checks and adjusts hydraulic component mounting and alignment.

COMPETENCY: Use dial indicators and gauges to check hydraulic component mounting and alignment, and adjust to manufacturer's specifications.

CRITERION: Can check and adjust alignment and mounting to manufacturer's specifications using dial indicators and gauges.

Can check and adjust belt tension and alignment to specifications.

SKILL/PROCESS:

1. Clean components to make ready for inspection
2. Use measuring instruments to determine if components are misaligned or bent
3. Check belt pulley alignment and adjust belt tension to manufacturer's specifications

KNOWLEDGE/THEORY:

1. Mounting alignment
    a. Radial run-out
    b. Belt and pulley alignment
    c. Gear alignment and clearances
2. Adjustments
    a. Belt tension
    b. Gear clearances
3. Checks
    a. Tension gauge
    b. Dial indicators
    c. Feeler gauge
    d. Straightedge
    e. Visual

VALUE/ATTITUDE CONCEPTS: Understands importance of alignment in prevention of damage and wear.

TASK AREA: Hydraulics

TASK #23: Removes and replaces hydraulic cylinders.

COMPETENCY: Remove and replace cylinders and make hydraulic connections using recommended procedures.

CRITERION: Can secure vehicle in a safe position for repair.

Can disconnect and reconnect hydraulic fittings without damage and without allowing dirt to enter the system.

Can use appropriate lifting gear to remove and replace cylinder without damage to cylinder or vehicle.

Can bleed air from hydraulic system.

Can replace lost hydraulic oil.

SKILL/PROCESS:

1. Secure vehicle in safe position so necessary repairs can be made
2. Clean exterior surfaces around hydraulic lines and cylinders
3. Remove hydraulic lines and seal openings to protect against contamination
4. Remove hydraulic cylinder following recommended procedure
5. Install new or rebuilt cylinder and connect hydraulic lines
6. Check operation of replaced cylinder, replacing lost oil and checking for external leaks

KNOWLEDGE/THEORY:

1. Function - Converts fluid power to mechanical power
2. Types
   a. Piston - straight movement
   b. Vane - rotary movement
   c. Single action - one-way
   d. Double action - force two-way
3. Components - exterior connection
   a. Shaft mount
   b. Cylinder housing mount
   c. Oil line
4. Bleeding cylinder

VALUE/ATTITUDE CONCEPTS: Understands importance of safety practices.

Awareness of keeping contamination out of system.

TASK AREA: Hydraulics

TASK #24: Straightens and polishes hydraulic cylinder shaft.

COMPETENCY: Straighten and polish hydraulic cylinder shaft to a serviceable condition.

CRITERION: Can use appropriate press and bend shaft.

Can use measuring instruments to determine if shaft is straight within manufacturer's specifications.

Can select and use appropriate polishing materials to produce a smooth surface finish.

SKILL/PROCESS:

1. Set shaft in press and bend to a straight condition
2. Use dial indicator or other instruments to measure straightness
3. Compare readings to manufacturer's specifications
4. Select polishing materials and methods and polish shaft

KNOWLEDGE/THEORY:

1. Type of hydraulic cylinder
    a. Piston type
    b. Ram type
2. Methods of straightening
    a. Hydraulic press
    b. V-blocks
    c. Dial indicator check
    d. Lathe method for checking straightness
3. Method of polishing
    a. Abrasive
    b. Oils
    c. Crocus cloth

VALUE/ATTITUDE CONCEPTS: Awareness of precision work and cost.

TASK AREA: Hydraulics

TASK #25: Repairs or rebuilds hydraulic cylinders.

COMPETENCY: Repair or rebuild hydraulic cylinder to manufacturer's specifications using correct procedures.

CRITERION: Can disassemble cylinder without damage to parts.

Can inspect parts and determine damage, if any, and cause of damage.

Can replace packing and o-rings to assure no leaks.

Can reassemble cylinder to operate without binding.

SKILL/PROCESS:

1. Clean and remove cylinder and disassemble cylinder without damage to parts
2. Visually inspect parts for damage and determine cause of damage
3. Reassemble, replacing all packing and o-rings
4. Operate cylinder and check for leaks and proper operation

KNOWLEDGE/THEORY:

1. Construction of cylinder and function of part
    - a. Rod
    - b. Barrel or housing
    - c. Packings
    - d. Seals
2. Types
    - a. Piston
        - (1) Single acting
        - (2) Double acting
    - b. Vane type
3. Types of problems
    - a. Leakage
        - (1) Internal
        - (2) External
    - b. Mechanical damage
        - (1) Damaged cylinder
        - (2) Damaged piston

VALUE/ATTITUDE CONCEPTS: Awareness of importance of cleanliness in repair of cylinder components.

Awareness of importance to lubricate packing and o-rings.

TASK AREA: Hydraulics

TASK #26: Tests hydraulic systems for leaks (internal-external).

COMPETENCY: Operate and test hydraulic systems to determine if components function to manufacturer's recommendations without leaks.

CRITERION: Can operate hydraulic system.

Can make visual inspection and find large and small leaks.

Can hook up and operate test equipment to determine which component is leaking internally.

Can use hydraulic schematic diagrams.

SKILL/PROCESS:

1. Run machine and allow oil to reach operating temperature
2. Operate all functions and inspect for external leaks
3. Read and interpret hydraulic schematic diagrams to determine possible places for internal leaks
4. Hook up gauges and flow meters on different functions to find internal leaks

KNOWLEDGE/THEORY:

1. External leaks
   a. Visual
   b. Under pressure
2. Internal leaks
   a. Symptoms
      (1) Foamy fluid
      (2) Spongy operation
      (3) Leak down
      (4) No operation
   b. Causes
3. Test equipment - hydraulic tester
   a. Flow meter
   b. Viscometer
   c. Pressure gauge

VALUE/ATTITUDE CONCEPTS: Awareness of accuracy and importance of preventative maintenance.

TASK AREA: Servicing

TASK #27: Changes engine oil.

COMPETENCY: Drain and refill engine oil to correct level with proper grade and weight of oil.

CRITERION:

Can secure vehicle in a safe position for oil change.

Can bring engine to normal temperature for oil change.

Can allow proper period of time for drainage of oil and sludges or connect and operate automatic drain system.

Can select correct grades of lubricants for replacement.

Can properly secure drain plug to assure sealing against leaks.

Can fill to correct level and run engine at proper r.p.m. to check level of oil and oil pressure and assure no leakage.

Can maintain engine oil maintenance records.

SKILL/PROCESS:

1. Secure vehicle for safe engine operation and normalize engine temperatures
2. Remove engine oil
    a. Remove engine oil by gravity drain method, removing drain plug and allowing proper drain down time
    b. Remove engine oil by automatic method by setting up, connecting, and operating such drain equipment safely and correctly
3. Secure drain plug to assure no leakage
4. Fill engine with correct oil type and amount of oil
5. Run engine and check for oil leaks
6. Recheck for proper oil level and record information on maintenance records, if appropriate

KNOWLEDGE/THEORY:

1. Principles of oil pan design
    a. Capacities
    b. Drain plug location
    c. Drain plugs
2. Principles of lubricating oils
    a. SAE weight
    b. API classification
3. Techniques of changing oil
    a. Oil temperature
    b. Drain time period
        (1) Gravity drain
        (2) Mechanical drain
    c. Drain plug replacement
    d. Oil replacement

4. Techniques of securing vehicle
    a. Transmission
    b. Brakes
    c. Cab jacks and safety latches
    d. Wheel chocks
5. Techniques of running engine
    a. Starting systems
        (1) Key switch
        (2) Start button
        (3) Override systems
    b. rpm
6. Principles of record system
    a. Function
    b. Process

VALUE/ATTITUDE CONCEPTS: Awareness of the importance of the oil and its condition in maintaining the vehicle.

TASK AREA: Servicing

TASK #28: Changes engine oil filters.

COMPETENCY: Remove, select, and replace engine oil filters using recommended procedures.

CRITERION: Can locate and identify engine all engine oil filters on vehicle for changing.

Can safely secure vehicle and properly remove types of filter or elements (cans or elements).

Can select proper replacement filter or elements.

Can clean filter housing area to assure removal of foreign particles and old oil.

Can replace and properly install correct oil filter and secure without damage and assure no oil leakage.

Can run engine to check for oil leaks, oil level, oil pressure and refill to correct level with proper oil.

Can maintain engine oil filter maintenance records.

SKILL/PROCESS:

1. Identify engine model and locate all engine filters for changing
2. Properly secure vehicle for removal of all types of filter elements or cams
3. Clean filter housing of old oil or foreign particles
4. Select proper filter and install without damage or leaks
5. Run engine and check for leaks and correct oil pressure
6. Stop engine, check oil level, and refill crankcase to correct level
7. Record type of filter, type of oil, and mileage for maintenance records

KNOWLEDGE/THEORY:

1. Function of oil filters
2. Principles of lubrication systems
    a. Fuel flow
    b. Bypass
    c. Full flow - bypass combination
3. Principles of oil filter elements
    a. Construction
        (1) Surface
        (2) Depth
    b. Design
        (1) Spin-on
        (2) Cartridge
4. Principles of oil filter containers
    a. Design
    b. Locations
5. Principles of lubricating oil
    a. SAE weight
    b. API classification

6. Techniques of changing filter elements
    a. Oil removal
    b. Element removal
    c. Cleaning
    d. Gaskets
    e. Installation
7. Techniques of vehicle securing
    a. Transmission
    b. Brakes
    c. Cab jacks - cab safety latch
    d. Wheel chocks
8. Techniques of running engines
    a. Starting systems
        (1) Key system
        (2) Start button
        (3) Override system
    b. rpm
9. Principles of record systems
    a. Function
    b. Process

VALUE/ATTITUDE CONCEPTS: Awareness of the importance of oil filter in keeping the engine clean.

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TASK AREA: Servicing

TASK #29: Changes engine fuel filters.

COMPETENCY: Remove, select, and replace engine fuel filters with correct replacement using recommended procedures.

CRITERION: Can secure vehicle in a safe position for engine fuel filters removal.

Can identify and select proper replacement engine fuel filters.

Can follow safety procedures to remove fuel filters.

Can refill filters with fuel and correctly install to assure no air or fuel leaks.

Can run engine to check to assure no air and fuel leakage and that engine runs properly.

Can maintain engine fuel filter maintenance records.

SKILL/PROCESS:

1. Secure vehicle in safe manner for the removal of fuel filters
2. Locate all fuel filters and clean exterior area to prevent contamination of fuel system
3. Remove fuel filters
4. Select proper replacement filters
5. Fill filters with clean fuel
6. Install filters to assure no leakage of fuel or air
7. Run engine to confirm no fuel or air leakage
8. Record information as applicable

KNOWLEDGE/THEORY:

1. Function of fuel filters
    a. Foreign particles
    b. Water
2. Principles of fuel system
    a. Fuel tank
    b. Fuel pumps
    c. Transfer pumps
    d. Hoses or piping
3. Principles of fuel filters
    a. Construction
        (1) Surface
        (2) Depth
    b. Design
        (1) Spin-on
        (2) Cartridge
4. Principles of fuel filter containers
    a. Design
    b. Location
5. Techniques of changing fuel filters
    a. Removal
        (1) Contamination
        (2) Safety

        - b. Selection
        - c. Installation
            - (1) Contamination
            - (2) Prior filling
            - (3) Leakages
6. Techniques of securing vehicle
    - a. Transmission
    - b. Brakes
    - c. Cab jacks and safety latches
7. Techniques of running engines
    - Starting systems
        - (1) Key system
        - (2) Start button
        - (3) Override system
8. Principles of record system
    - a. Function
    - b. Process

VALUE/ATTITUDE CONCEPTS: Awareness of the importance of the fuel filter in keeping fuel clean for proper operation of the fuel system.

TASK AREA: Servicing

TASK #30: Services engine water filters.

COMPETENCY: Remove, select, and replace water filters with correct replacement according to recommended procedures.

CRITERION: Can secure vehicle in a safe position for changing engine water filters.

Can identify and select proper engine water filters.

Can remove and replace filter with minimum loss of coolant.

Can run engine to check for correct level of coolant.

SKILL/PROCESS:

1. Park vehicle and raise cab or hood in a safe position for access to the engine
2. Identify type of filter and procure replacement
3. Close valves if appropriate and replace bag type or spin-on filter
4. Open valves, run engine, and check coolant level in radiator

KNOWLEDGE/THEORY:

1. Function of water filters
   a. Engine protection
   b. Cooling system protection
2. Principles of water filters
   a. Foreign particles
   b. Acid concentrations
   c. Electrolytic action
   d. Water softeners
   e. Rust preventative
3. Types of water filters
   a. Construction
      (1) Spin-on
      (2) Elements
   b. Materials
      (1) Cromate
      (2) Non-cromate
4. Techniques of servicing water filters
   a. Removal of filter
      (1) Spin-on
      (2) Element
   b. Selection of replacement filter
      Compatability
5. Techniques of securing vehicle
   a. Transmission
   b. Brakes
   c. Cab jacks - safety latch
   d. Wheel chocks

VALUE/ATTITUDE CONCEPTS: Awareness of proper operation of the cooling system and its effect on engine life and efficiency.

TASK AREA: Servicing

TASK #31: Services air filters.

COMPETENCY: Service the air intake system by using correct procedures to determine the necessary corrections.

CRITERION: Can secure vehicle in a safe manner for changing air filters.

Can locate, identify and can select correct replacement filters.

Can determine appropriate service for air filter; wet type or dry type.

Can follow proper procedures to clean or replace filter.

Can install filter using proper lubricants and levels for wet type filters.

Can maintain air filter maintenance records.

SKILL/PROCESS:

1. Secure vehicle in safe manner for changing air filters
2. Locate filters
3. Determine type of filter and appropriate service needed on wet or dry types
4. Replace filter using proper procedures and lubricants
5. Record type of filters and mileage for maintenance records

KNOWLEDGE/THEORY:

1. Function of air system
   a. Cleaning of air
   b. Cooling air
   c. Silencing of air noise
   d. Furnish air requirements for combustion
2. Principles of air cleaning or filtration
   a. Dirt removal or efficiency
   b. Resistance to air flow
   c. Size and shape in relation to engine
3. Types of air filters
   a. Centrifugal or metric
   b. Dry
      (1) Paper
      (2) Cloth
      (3) Spun glass
   c. Oil bath
4. Types of restriction test units
   a. Vacuum gauge
   b. Monometers
   c. Restriction indicators
   d. Visual or 75 watt light bulb
5. Methods of servicing air filters
   a. Replacement: Dry type
      (1) Selection
      (2) Installation

    b. Cleaning: Dry type
        (1) Washable type
        (2) Air blow-out
    c. Cleaning: Wet type
        (1) Method of cleaning
        (2) Oil selection and quantity
6. Techniques of securing vehicles
    a. Transmission
    b. Brakes
    c. Cab jacks, safety latch
    d. Wheel chocks
7. Principles of record system
    a. Function
    b. Process

VALUE/ATTITUDE CONCEPTS: Awareness of air filters effect on fuel consumption.

TASK AREA: Servicing

TASK #32: Lubricates vehicle.

COMPETENCY: Lubricate vehicles using correct procedures and lubricants.

CRITERION: Can secure vehicle in proper position and safe manner for lubrication.

Can identify lubrication points and clean and select proper lubricants.

Can select and use correct lubrication equipment for each lubrication point.

Can maintain lubrication records.

SKILL/PROCESS:

1. Secure vehicle in safe and proper position for lubrication
2. Locate, clean, and determine type of lubricants needed for each lubrication point
3. Lubricate each lubrication point with properly selected lubricant and lubricating equipment
4. Record information as applicable

KNOWLEDGE/THEORY:

1. Reason for lubrication
    a. Prevent wear
    b. Efficiency of operation - ease of movement
2. Lubricants' composition
    a. Petroleum or mineral base
    b. Chemical base
    c. Vegetable base
3. Types of lubricants
    a. Greases
        (1) Multipurpose gear
        (2) Chassis
        (3) Steering
        (4) High temperature
        (5) Soft, smooth cup
        (6) Special
        (7) High temperature (special)
    b. Oils
        (1) Engine
        (2) Lubricating oil - special
        (3) Gear
        (4) Refrigerant
    c. Fluids
        (1) Hydraulic brake
        (2) Type "A"
    d. Petroleum jelly
4. Characteristics
    a. Viscosity
    b. Temperature
    c. Grades
    d. Cooling
    e. Cleaning agent - detergent

5. Deterioration of lubricants
    a. Contaminants
        (1) Dirt
        (2) Wear metal
        (3) Combustion
        (4) Water
        (5) Chemicals
    b. Heat effects
        (1) Molecular breakdown
        (2) Dissipation of chemicals
    c. Loss
        (1) By leakage
        (2) Force out
6. Lubrication methods
    a. Pressure systems
        (1) Mechanical
        (2) Automatic
    b. Pressure pump
    c. Drain and fill
        (1) Gravity
        (2) Suction
    d. Hand pack
7. Lubrication points
    a. Crankcase
    b. Chassis
    c. Axles
    d. Transmissions
    e. Engine components
    f. Accessories
8. Filtering oils
    a. Purpose
    b. Types
        (1) Pleated paper
        (2) Cotton absorbent
        (3) Wire mesh
        (4) Surface
9. Lubrication techniques
    a. Securing and positioning of vehicle
    b. Cleaning
    c. Specifications and lubrication charts
    d. Appropriate procedures
    e. Correctly specified lubricants
10. Recording and record keeping
    a. System
    b. Importance

VALUE/ATTITUDE CONCEPTS: Awareness of how proper lubrication affects the life of the vehicle and acts as a prevention against maintenance.

TASK AREA: Servicing

TASK #33: Services gear box oil for level or need to change.

COMPETENCY: Service gear oil to determine need for changing or correcting levels and services with correct viscosity of oil.

CRITERION: Can secure and position vehicle safely in proper position for checking of gear oil.

Can identify all gear boxes requiring oil and determine needed services.

Can select correct gear oil types and viscosity for gear box being serviced.

Can fill to proper levels and secure to prevent leakage and loss of lubricants.

Can maintain service records for gear box oil services.

SKILL/PROCESS:

1. Secure vehicle safely checking gear oil
2. Identify gear boxes
3. Select gear oils and viscosity for gear box being serviced
4. Drain oil if appropriate and refill to correct level
5. Check gear box for leakage
6. Record type of lubricants and mileage for maintenance records

KNOWLEDGE/THEORY:

1. Function of gear lubricants
    a. Friction
    b. Cleaning
    c. Rust and corrosion
    d. Cooling
2. Principles of lubricants
    a. Viscosity - SAE numbers
    b. HPI gravity
    c. E.P. additives - film strength
    d. Lubricants additives
3. Principles of gear box servicing
    a. Location of drain plugs
    b. Location of filler plugs
    c. Type lubricant for specific gear boxes
    d. Cleaning - contamination
    e. Change frequency
4. Techniques of servicing gear boxes
    a. Cleaning - contamination
    b. Draining or addition of lubricants
5. Types of lubricant pumps
    a. Mechanical - Hand operated
    b. Air operated
6. Techniques of securing vehicle
    a. Transmission
    b. Brakes

    c. Cab jack - safety latch
    d. Wheel chocks
7. Maintenance record system
    a. Function
    b. Process

VALUE/ATTITUDE CONCEPTS: Awareness of oil function and its effect on proper operation of the vehicle.

TASK AREA: Servicing

TASK #34: Services radiator shutter system.

COMPETENCY: Check operation and adjust and service radiator shutter system according to specifications.

CRITERION: Can secure vehicle in safe manner for checking system.

Can service filters on vehicle with filters using correct materials and fluids.

Can check radiator shutter system under correct conditions to assure shutter closes and opens at proper operating temperature range.

SKILL/PROCESS:

1. Park vehicle and raise hood or cab in a safe manner for access to engine
2. Clean and lubricate air filter, if equipped, in shutter system
3. Inspect mechanical operation of shutters and linkage for free movement
4. Run engine to allow coolant to warm up and observe opening of shutter at maximum desired temperature and closing at minimum desired temperature
5. Make necessary changes in thermostat or shutterstat to make system operate as desired

KNOWLEDGE/THEORY:

1. Function of shutter systems
   a. Temperature control
   b. Engine wear
2. Function of shutter system components
   a. Shutters
   b. Shutter actuation mechanism
      (1) Air cylinders
      (2) Thermostatic/mechanism linkage
   c. Shutter control mechanism
      (1) Thermostatic - air
      (2) Thermostatic - electric
3. Techniques of servicing shutter systems
   a. Shutters and linkage - lubrication
   b. Filters
      (1) Cleaning
      (2) Lubrication
   c. Shutter slats-adjustment
4. Techniques of securing vehicle
   a. Transmission
   b. Brakes
   c. Cab jacks - safety latch
   d. Wheel chocks
5. Techniques of running engine
   Starting systems
      (1) Key systems

(2) Start button
(3) Override system

VALUE/ATTITUDE CONCEPTS: Aware of how system affects cooling and engine efficiency.

TASK AREA: Servicing

TASK #35: Checks and inflates tires.

COMPETENCY: Check and adjust tire pressure to correct pressure and visually check tires for conformance to safety standards.

CRITERION: Can check pressure with pressure gauges and inflate tires to correct pressure rating.

Can inspect tire tread for wear and identify uneven wear, depth of wear, blisters, breaks and whether tire tread depth conforms to DOT standards.

SKILL/PROCESS:

1. Check tire pressure with pressure gauge and correct when necessary.
2. Check tread depth with gauge and determine if tire conforms to D.O.T. standards.
3. Check tire visually for wear or defects to determine if tire conforms to D.O.T. standards.

KNOWLEDGE/THEORY:

1. Tire design
    a. Material
    b. Construction
        (1) Radial
        (2) Bias
    c. Tread design
    d. Ratings
    e. Inflation
2. Techniques of tire inspection
    a. DOT standards
    b. Visual inspection
        (1) Damage
        (2) Over inflation
        (3) Under inflation
        (4) Alignment wear
    c. Tread depth indicators
3. Techniques of tire inflation
    a. Gauging tire pressure
    b. Adjusting air pressure

VALUE/ATTITUDE CONCEPTS: Awareness of safety in handling tires.

Awareness of effects of tire pressure on safety, wear of tires, and efficiency of operation.

NOT INCLUDED IN THE
DIESEL VEHICLE MAINTENANCE
CURRICULUM

TASK AREA:	Servicing
TASK #36:	Checks track and rollers.
COMPETENCY:	Check and adjust track tension and visually inspect pins, rollers and shoes for serviceability.
CRITERION:	Can secure vehicle in a safe position for servicing. Can clean and inspect pins, rollers and track shoes for wear. Can inspect sprocket and front idler for wear. Can measure track tension and manually adjust according to manufacturer's procedures.
SKILL/PROCESS:	1. Park vehicle in a safe manner for work on tracks 2. Clean dirt from tracks and inspect components for wear 3. Inspect idlers and sprockets for wear 4. Measure sag in tracks between idler rollers and adjust front idler for correct tension

TASK AREA: Servicing

TASK #37: Services and tests batteries.

COMPETENCY: Visually inspect, test, and service batteries to conform to proper safety and operating standards.

CRITERION: Can secure vehicle in safe position for battery service.

Can visually inspect batteries for needed service and conformity to DOT standards.

Can clean and replace terminals with correct replacement parts.

Can check and adjust electrolyte to proper level by adding water.

Can test batteries using correct test instrument to determine condition of battery.

SKILL/PROCESS:

1. Remove cables from battery and secure vehicle for safe battery service.
2. Clean and inspect battery cables and battery holddowns for conformance to D.O.T. standards.
3. Adjust electrolyte to proper level by adding water.
4. Determine condition of battery with correct test instrument.

KNOWLEDGE/THEORY:

1. Principles of batteries
    - a. Construction
    - b. Chemical action
    - c. Voltage
    - d. Amperage
    - e. Specific gravity
2. Principles of battery cables and connectors
    - a. Material
    - b. Insulation
    - c. Length
    - d. Ends or connectors
3. Principles of electricity
    - a. Voltage
    - b. Amperage
    - c. Resistance
4. Techniques of cable construction and installation
    - a. Soldering
    - b. Crimping
    - c. Routing
    - d. Clamping
5. Battery installation
    - a. Battery boxes and mounting
    - b. Battery box covers
    - c. Battery hold-down
6. Techniques of battery and battery box servicing
    - a. Visual inspection
        - (1) Damage
        - (2) Looseness of mounting bolts
        - (3) Corrosion

b. Corrosion removal
    (1) Mechanical
    (2) Chemical
c. Electrolyte adjustment
    (1) H_2O
    (2) H_2SO_4
d. Testing
    (1) Specific gravity
    (2) Load test
    (3) Internal resistance test

VALUE/ATTITUDE CONCEPTS: Awareness of safety in handling batteries.

TASK AREA: Servicing

TASK #38: Repairs exhaust system.

COMPETENCY: Inspect, test and repair exhaust system to conform to proper safety and operating standards.

CRITERION: Can secure vehicle in safe manner for servicing and repairing exhaust system.

Can run engine, inspect and identify needed repairs for safety and operating standards.

Can make needed repairs, selecting correct replacement parts or repairing parts to conform to manufacturer's specifications.

SKILL/PROCESS:

1. Secure vehicle in safe manner for servicing and repairing exhaust system
2. Install test equipment and tune engine to determine if noise and back-pressure conform to manufacturer's and D.O.T. standards; visually check for exhaust leaks or damage
3. Make necessary repairs of install correct parts to assure proper and safe engine and vehicle operation

KNOWLEDGE/THEORY:

1. Function of exhaust system
    a. Silencing of exhaust pressure waves
    b. Elimination of exhaust gases
2. Principles of exhaust systems
    a. Mufflers or silencers
        (1) Noise levels
        (2) Back pressures
    b. Piping
        (1) Materials
        (2) Size
        (3) Connectors
        (4) Elbows
3. Techniques of servicing exhaust systems
    a. Noise measurement
        (1) Human ear or experience
        (2) Decibel meter
    b. Back pressure testing
        (1) Manometer
        (2) Pressure gauge
    c. Muffler replacement
        (1) Size
        (2) Construction
    d. Piping replacement
        (1) Size
        (2) Material
        (3) Connectors
4. Techniques of running engine for testing

a. Start systems
    (1) Key system
    (2) Start button
    (3) Override systems
b. rpm and load

VALUE/ATTITUDE CONCEPTS: Awareness of effects of exhaust gases and the importance of a proper functioning system for efficiency and safety.

TASK AREA: Servicing

TASK #39: Inspects and adjusts belts.

COMPETENCY: Inspect, replace, and adjust belts to proper belt specifications.

CRITERION: Can secure vehicle in safe position for making inspections, adjustments and/or replacement of parts.

Can inspect and identify maintenance needs for adjustments and/or replacement.

Can select proper belts, replace and adjust to proper engine manufacturer's specifications.

SKILL/PROCESS:

1. Secure vehicle safely before making adjustment or replacement of parts
2. Check belts for wear or broken spots before making adjustments
3. Select belts for replacement if necessary and adjust belt tension and alignment according to manufacturer's specifications

KNOWLEDGE/THEORY:

1. Function of belts
2. Belt construction and sizing
   a. Materials
   b. Size
      (1) Length
      (2) Width
   c. Construction
3. Techniques of belt replacement
   a. Types of adjusters
   b. Selection of belts
   c. Belt tension
   d. Belt alignment

VALUE/ATTITUDE CONCEPTS:

Awareness of safety precautions in observing belt operations and in making adjustments.

Awareness of alignment effect on belt life.

TASK AREA: Servicing

TASK #40: Services vehicle lighting system.

COMPETENCY: Check and test lighting system and make repairs to insure proper operation and conformance to safety standards.

CRITERION: Can visually check lighting system to identify visual damage or malfunctions.

Can use correct test instruments and trouble-shooting procedures to trace and locate problem.

Can make repair by replacing damaged component with correct replacement part or repair damaged component.

Can check and aim headlamp beams to conform to State inspection standards.

SKILL/PROCESS:

1. Observe all lights for proper operation and inspect system for broken lenses and other damage
2. Use test lights or meters to locate defective wiring or switches
3. Repair or replace defective components
4. Check and adjust headlamp aim

KNOWLEDGE/THEORY:

1. Function of lights
    a. Visability
    b. Turn indicator
    c. Warning lights
    d. Clearance lights
2. Lighting circuit components
    a. Bulbs
    b. Holders
    c. Wiring
    d. Switches
    e. Fuses
    f. Circuit breakers
    g. Connectors
3. Principles of electricity
    a. Voltage
    b. Amperage
    c. Resistance
4. Wiring identification systems
    a. Color coding
    b. Numerical coding
    c. Wire size
    d. Wire insulation
5. Function of test equipment
    a. Voltmeter
    b. Ampmeter
    c. Test light
    d. Ohmmeter
6. Techniques of testing light operation
    a. Continuity test
        (1) Ohmmeter

        - (2) Test light
        - (3) Voltmeter
    - b. Current draw test
- 7. Techniques of adjusting headlights
    - a. State standards
        - (1) Candle power
        - (2) Aiming
    - b. Test instruments
        - (1) Wall chart aimers
        - (2) Optical aimers
        - (3) Bulb aimers

VALUE/ATTITUDE CONCEPTS: Awareness of safety factors involved with the electrical and lighting system such as avoidance of sparks and overheating wires and proper lighting for road safety.

TASK AREA: Servicing

TASK #41: Services windshield wiper system (air and electric).

COMPETENCY: Inspect wiper system to determine operating condition and make necessary repairs to conform to safety and operating standards.

CRITERION: Can identify wiper malfunctions and determine procedure for correcting.

Can replace wiper blades with correct replacement blades.

Can check for hose, piping and air system component leaks and visual damage.

Can select and replace component parts with correct replacement parts correcting air leakage.

Can make adjustments for proper wiping sweep pattern.

SKILL/PROCESS: Servicing Wiper Systems

1. Determine probable cause of wiper system malfunction by checking operation.
2. Check wiper blades and replace blades if needed.
3. Adjust wiper sweep pattern.

Repairing Air Wiper System

1. Inspect for air leaks by checking hose and piping and identify damaged hose or piping
2. Replace with correct replacement hose or piping
3. Check for air pressure at control
4. Check control
5. Replace control by:
   a. Shutting off air supply
   b. Disconnecting air lines
   c. Replacing control with correct replacement
   d. Reconnecting air lines
   e. Checking for air leaks and operation
6. Replace air motor by:
   a. Shutting off air supply
   b. Disconnecting air lines
   c. Removing wiper arms and/or transmission cables
   d. Removing motor
   e. Selecting replacement motor
   f. Installing replacement motor
   g. Reconnecting lines, wiper arms, and/or transmission cables
   h. Checking for air leaks and operation
   i. Adjusting sweep

Repairing Electrical Wipers

1. Check system to establish starting points for troubleshooting
2. Check fuse and replace if necessary

3. Check wiring and replace or repair as needed
4. Check control
5. Replace control
    a. Disconnect fuse wire
    b. Label and remove wince from control
    c. Remove and replace control
    d. Reconnect wires and replace fuse
    e. Check for proper operation
6. Check motor
7. Replace motor
    a. Disconnect fuse
    b. Label and remove wires from control
    c. Remove wiper arm and/or transmission cables
    d. Remove motor and replace with correct replacement
    e. Reconnect wiring, arm, and/or transmission cables
    f. Check operation of system and adjust wiper sweeps

KNOWLEDGE/THEORY:

1. Function of wiper system
2. System components
    a. Electric systems
        (1) Motor
        (2) Fusing
        (3) Wiring
        (4) Switches
    b. Air wiper system
        (1) Air motors
        (2) Air lines
        (3) Air controls
    c. Blades
    d. Arms
    e. Transmissions
        (1) Cables
        (2) Eccentric
3. Adjustments
    a. Speed control
    b. Synchronization
    c. Lash
    d. Centering
4. Servicing
    a. Replacing blades
    b. Lubricating

VALUE/ATTITUDE CONCEPTS:

Awareness of the importance of the wiper system for road safety.

TASK AREA: Servicing

TASK #42: Performs vehicle safety inspection.

COMPETENCY: Inspect vehicle to determine compliance to D.O.T. safety inspection regulations.

CRITERION: Can follow D.O.T. safety inspection procedures and inspect vehicle according to prescribed procedures.

Can determine compliance and non-compliance of each safety inspection item.

Can make recommendation as to correction of safety items in non-compliance with D.O.T. standards.

SKILL/PROCESS:

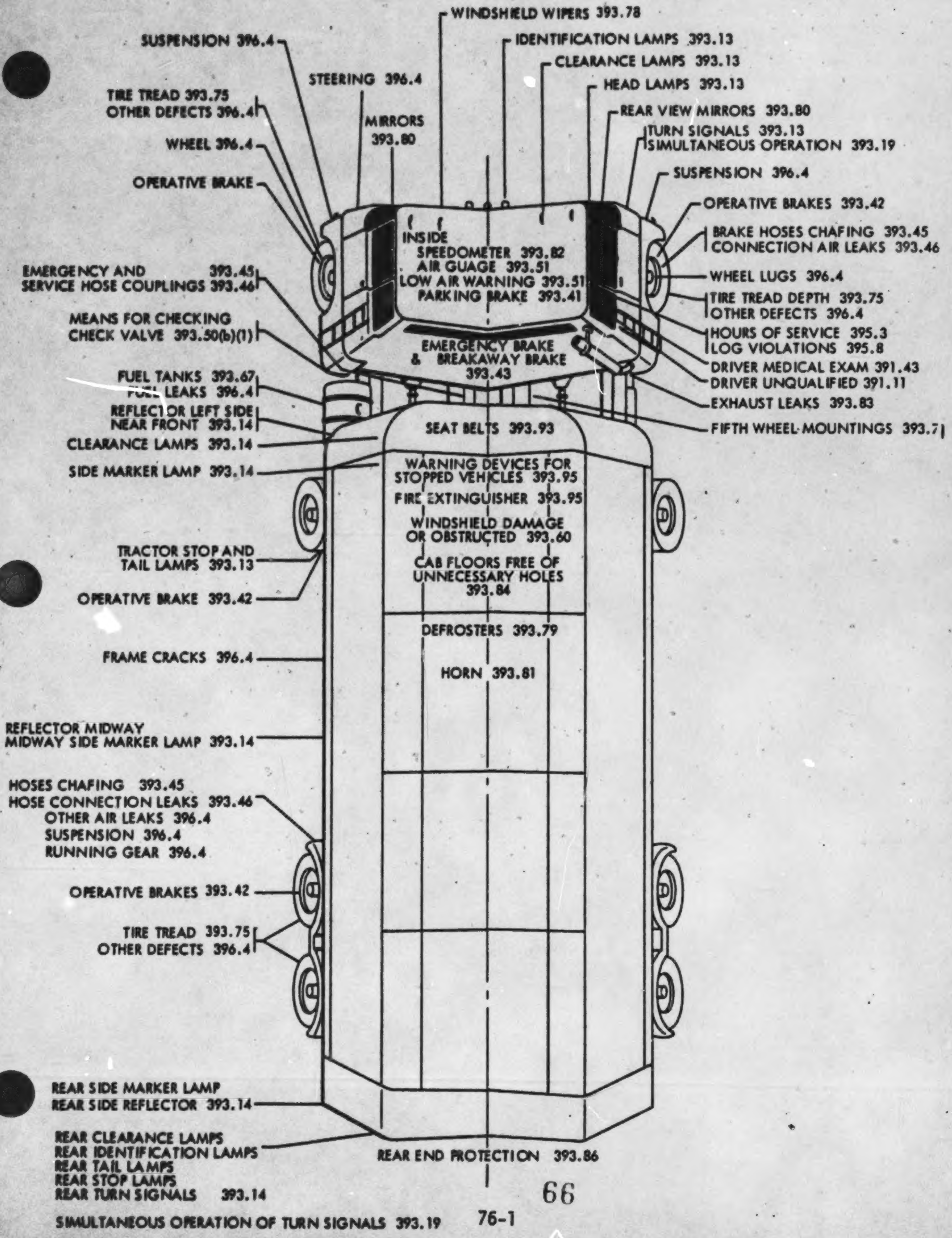
1. Secure vehicle for safe engine operation to perform safety inspection
2. Obtain inspection record check procedure
3. Perform safety inspection of vehicle according to prescribed procedures
4. Determine compliance of vehicle to D.O.T. regulations
5. Make recommendation on repairs for non-compliance items

KNOWLEDGE/THEORY:

1. Function of safety inspection
2. Principles of lamps and reflectors
    a. Location
    b. Types
    c. Quantity
3. Principles of wiring
    a. Construction
    b. Location
    c. Securing
4. Principles of brakes
    a. Service brake operation
    b. Parking brake operation
    c. Tractor-trailer separation protection
    d. Hoses and lines
    e. Brake linings
    f. Air pressure gauges and warning devices
5. Glass inspection and function
    a. Discoloration
    b. Damage
6. Fuel system components, function, location
    a. Fuel containers
    b. Fuel filler tubes
    c. Leakage
    d. Fuel lines
7. Principles of fifth wheels
    a. Attachment
    b. Locking mechanism
8. Principles of tires, wheel, and hubs
    a. Tread depth
    b. Damage
    c. Lugs

9. Emergency equipment, components, and location
    a. Fire extinguisher
    b. First aid kit
    c. Warning devices
10. Cab, frame, and suspension construction
    a. Exhaust system
    b. Secure cab
    c. Frame damage
    d. Suspension
    e. Steering
    f. Mirrors

VALUE/ATTITUDE CONCEPTS: Awareness of the importance of the D.O.T. inspection system for driver and public safety.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REAR TAIL LAMPS
REAR STOP LAMPS
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TASK AREA: Servicing

TASK #43: Services and repairs cab heating and air conditioning system.

COMPETENCY: Service and repair cab heating and air conditioning system to determine and make adjustments and repairs for proper operation.

CRITERION: Can use test instruments and follow test procedures to identify malfunctioning component in heating or air conditioning system.

Can replace malfunctioning component with correct replacement part following recommended procedures.

Can charge system with correct refrigerant materials to manufacturer's specifications.

Can adjust controls and linkages to operate system within proper settings.

SKILL/PROCESS:

1. Secure vehicle in safe manner to operate engine and check heating and air conditioning system
2. Heater system
   a. Clean and blow out heater core with compressed air
   b. Lubricate cables, controls, and motors
   c. Check operation of water control valve for full open to full close
   d. Lubricate and adjust duct doors
3. Service air conditioning system
   a. Clean and blow out condenser and evaporator with compressed air
   b. Lubricate cables, controls, and motors
   c. Check and adjust belts
   d. Install service gauges into air conditioning system
   e. Start engine, operate air conditioning unit, and observe readings of high and low pressure
4. Charge air conditioning system (low R-12 level)
   a. Install service gauges
   b. Charge system to proper level
5. Change clutch unit
   a. Remove belts
   b. Remove and replace clutch
   c. Install belts to proper tension and alignment
6. Replace receiver-dryer unit
   a. Safely remove R-12 from system
   b. R & R receiver-dryer not contaminating system
   c. Evacuate system
   d. Charge system with R-12 to proper level

7. Replace compressor
    a. Close service valves or safely remove R-12 from system
    b. Remove and replace compressor
    c. Adjust belts for tension and alignment
    d. Evacuate system if no service valves
    e. Charge system with R-12 to proper level
8. Replace expansion valve
    a. Remove R-12 safely from system
    b. Remove and replace expansion valve - not contaminating system
    c. Evacuate system
    d. Charge system with R-12 to proper level

KNOWLEDGE/THEORY:

1. Function of air conditioning and heating system
    a. Cleans
    b. Dehumidify
    c. Maintaining selected temperature
2. Principles of heat
    a. Intensity
    b. Latent
    c. British Thermal Unit
    d. Ambient temperature
    e. Transmission
        (1) Convection
        (2) Conduction
        (3) Radiation
3. Principles of refrigeration
    a. Evaporation
    b. Melting
    c. Charles' Law
    d. Boyle's Law
    e. Condensation
    f. Boiling point
    g. Vacuums
4. Principles of R-12 refrigerant
    a. Pressure-temperature relations
    b. Handling refrigerants
    c. R-12 evaporation and condensation
5. Principles of refrigerant system operation
    a. Compressor
    b. Condenser
    c. Receiver - drier
    d. Thermostatic expansion valve
    e. Evaporates
6. Principles of compressor controls
    a. Ambient temperature switch
    b. Thermostatic switch
    c. Low pressure cutout
    d. Time delay relay
    e. High pressure switch
    f. Thermal limiter and super heat switch
7. Principles of evaporator controls
    a. Section throttling valve (STV)
    b. Pilot operated absolute valve
    c. Valves-in receiver (VIR & VIR-EE)
    d. Evaporator pressure regulator valve (EPR)

    e. Evaporator temperature regulator valve (ETR)
    f. Evaporator pressure regulator II valve (EPRII)

8. Principles of system servicing
    a. Checking and adding refrigerant oil
    b. Gauge manifold set
    c. Service valve operation
        (1) Stem type
        (2) Schrader type
    d. Discharging system
    e. Flushing system
    f. Evacuation of system
    g. Charging system
        (1) Liquid charging
        (2) Gas charging

9. Principles of leak detection
    a. Halide propane torch
    b. Electronic detector
    c. Bubble detector
    d. Internal changed detector (dye)

10. Principles of refrigerant hoses and tubing
    a. Material
    b. Construction
    c. Fittings
    d. Copper soldering

VALUE/ATTITUDE CONCEPTS: Awareness of eye safety.

TASK AREA: Servicing

TASK #44: Services cooling system.

COMPETENCY: Service and test cooling system and makes necessary adjustments and repairs to insure correct operation of the cooling system.

CRITERION: Can check hoses and connections to identify leaks or potential malfunctions and replace or repair with correct parts.

Can clean external system using correct cleaning methods and procedures.

Can clean system by flushing using correct flushing procedures, methods and agents.

Can test coolants and adjust to proper coolant level and specific gravity.

Can check and adjust belts, fans and shutters for proper control of engine temperature.

SKILL/PROCESS:

1. Pressure test cooling system and inspect for leaks
2. Steam clean or wash external components
3. Flush system with chemicals or by reverse flushing
4. Replace defective components and refill system with correct amount of antifreeze and water
5. Test solution with antifreeze hydrometer to determine specific gravity level
6. Check and adjust tension of belts and operation of shutters

KNOWLEDGE/THEORY:

1. Principles of cooling system
   a. Removal of heat
      (1) Protection of engine components
      (2) Efficiency of operation
   b. Transfer of heat by
      (1) Conduction
      (2) Radiation
2. Function of cooling system components
   a. Blocks
   b. Hoses
   c. Radiator
   d. Fans & belts
   e. Thermostats
   f. Cooling medium
   g. Temperature control devices
3. Techniques of cleaning cooling system
   a. External cleaning
      (1) Air
      (2) Pressure washers
      (3) Chemicals

- b. Internal cleaning
    - (1) Chemicals
    - (2) Back flushing

4. Techniques of servicing cooling systems
    - a. Pressure testing
    - b. Hydrometer testing
    - c. Belt tension gauge
    - d. Running engine to temperature
        - (1) Shutter opening/closing
        - (2) Temperature controlled fan (when applicable)
        - (3) Thermostat opening
    - e. Water filters
        - (1) Spin-on
        - (2) Element
    - f. Cooling medium
        - (1) Water
        - (2) Antifreeze
        - (3) Chemical additives
5. Techniques of securing vehicle
    - a. Transmission
    - b. Brakes
    - c. Cab jacks and safety latches
    - d. Wheel chocks

VALUE/ATTITUDE CONCEPTS: Awareness of safety precautions when checking cooling system when engine is hot.

TASK AREA: Electrical

TASK #45 Replaces or repairs battery cables or cable ends.

COMPETENCY: Replace or repair battery cables to make mechanically and electrically sound connections.

CRITERION: Can correctly remove cables from battery and vehicle.

Can select and install cable of proper size and length and fit with connectors of correct size.

Can select proper tools to attach cable ends for mechanically and electrically effective connections.

Can route cable in chassis and secure to protect against wear.

SKILL/PROCESS:

1. Remove battery cables correctly from vehicle
2. Select correct size and length cable
3. Select tools to cut cable for installing ends
4. Clean battery post and ends
5. Install battery ends on cable
6. Route cable in chassis and clamp to prevent chafing

KNOWLEDGE/THEORY:

1. Function of battery cables
2. Principles of electricity
    a. Voltage
    b. Amperage
    c. Resistance
3. Battery cable - construction
    a. Material
    b. Insulation
    c. Length
    d. Ends
4. Principles of batteries
    a. Construction
    b. Chemical action
5. Techniques of cable construction and installation
    a. Soldering
    b. Crimping
    c. Routing
    d. Clamping
6. Corrosion

VALUE/ATTITUDE CONCEPTS: Awareness for safety precautions in working with electrical connections to avoid sparks, explosions, and burns.

TASK AREA: Electrical

TASK #46: Rebuilds electric starter motor.

COMPETENCY: Rebuild electric starter motor and test to assure performance according to manufacturer's specifications.

CRITERION: Can disassemble electric starter motor following correct safety procedures.

Can perform electrical test using appropriate equipment to determine serviceability of each component.

Can check bushings and bearings for wear and determine need for replacement.

Can make decisions on needed electrical and mechanical repairs.

Can correctly reassemble, adjust and test starter to assure performance to manufacturer's specifications.

SKILL/PROCESS:

1. Disassemble starter motor and clean components
2. Set up test equipment and perform electrical tests on fields, armature, brush holders, and solenoids
3. Check bushings and bearings for wear
4. Evaluate test results and visual inspections and make decisions on repair or replacement of parts
5. Make repairs and reassemble starter
6. Bench test starter

KNOWLEDGE/THEORY:

1. Function of electric starter motors
2. Principles of electricity and electromagnetism
   a. Voltage
   b. Amperage
   c. Resistance
   d. Magnetic fields
3. Types of electric starter motors
   a. Series wound
   b. Parallel wound
   c. Series-parallel wound
   d. Grounded
   e. Insulated
4. Starter components, function, cleaning, and testing
   a. Electrical components
      (1) Field coil
      (2) Armature
      (3) Brushes and holders
      (4) Insulators
   b. Electrical test equipment
      (1) Ampmeter
      (2) Voltmeter

        - (3) Ohmmeter
        - (4) Test light
        - (5) Growler
    - c. Mechanical components
        - (1) Housing
        - (2) Starter drives
            - (a) Inertia
            - (b) Overrunning clutch
            - (c) Sprag clutch
            - (d) Dyer drive
        - (3) Bearings and lubrication
- 5. Electrical test
    - a. Amperage draw
    - b. Open circuits
    - c. Ground circuits
    - d. No-load test
- 6. Mechanical checks
    - a. Bushing and bearing wear
    - b. Clearances
    - c. Brushes and spring tension
    - d. Clutch and drive
    - e. Spring tension
    - f. Commutator trueness and surface characteristics

VALUE/ATTITUDE CONCEPTS:

Awareness of accurate bench testing to assure proper functioning when starter installed on truck.

Awareness of delicate nature of test meters.

TASK AREA: Electrical

TASK #47: Performs starter ampere-draw test on vehicle.

COMPETENCY: Determine the ampere-draw needed to crank engine and compare test findings with manufacturer's specifications.

CRITERION: Can select and connect the proper test equipment for determining amperage-draw to determine if within manufacturer's specifications.

Can perform ampere-draw test as appropriate for test equipment being used.

Can compare test results with starter manufacturer's specifications and make recommendation as to needed repairs.

SKILL/PROCESS:

1. Select and hook up appropriate test equipment
2. Prepare engine for cranking for amperage draw test so engine will not start
3. Crank engine and observe motor readings
4. Compare readings with manufacturer's specifications
5. Make decision on needed repairs

KNOWLEDGE/THEORY:

1. Function of starter ampere-draw test
2. Principles of starter motors
    a. Construction
    b. Testing
        (1) No-load test
        (2) Load test
3. Principles of batteries
    a. Construction
    b. Testing
        (1) Specific gravity
        (2) Load test
4. Function of test equipment
    a. Voltmeter
    b. Ampmeter
5. Principles of electricity
    a. Voltage
    b. Amperage
    c. Resistance
6. Techniques of ampere-draw testing
    a. Direct reading
    b. Voltage drop
7. Techniques of securing vehicle
    a. Transmission
    b. Brakes
    c. Cab jacks and safety latches
    d. Wheel chocks
8. Principles of engine shut-down systems
    a. Electric
    b. Mechanical

VALUE/ATTITUDE CONCEPTS: Awareness of safety practices when working with electrical circuits.

TASK AREA: Electrical

TASK #48: Removes and replaces starter motor.

COMPETENCY: Remove and replace starter motor and test to assure proper operation according to specifications.

CRITERION: Can safely disconnect cables from battery and remove starter.

Can perform bench test on replacement starter motor to determine if it operates according to manufacturer's specifications.

Can install starter on engine and test for starting performance.

SKILL/PROCESS:

1. Remove battery cables from battery
2. Remove starter from engine
3. Perform test on replacement starter motor before installing
4. Determine if starter operates according to manufacturer's specifications
5. Install starter on engine
6. Test starter and wiring performance

KNOWLEDGE/THEORY:

1. Function of starter motors
2. Principles of starter motors
   a. Construction
   b. Testing
      (1) No-load test
      (2) Load test
   c. Mounting
      (1) Bolts
      (2) Wiring
3. Principles of wire identification
   a. Color coding
   b. Numerical coding
4. Principles of batteries
   a. Construction
   b. Testing
      (1) Specific gravity
      (2) Load test
5. Principles of electricity
   a. Voltage
   b. Amperage
   c. Resistance
6. Techniques of no-load testing
   a. Amperage
   b. RPM
7. Techniques of ampere-draw testing
   a. Direct reading
   b. Voltage drop
8. Techniques of securing vehicle
   a. Transmission
   b. Brakes
   c. Cab jacks and safety latches
   d. Wheel chocks

9. Principles of engine shut-down systems
    - a. Electrical
    - b. Mechanical
10. Function of test equipment
    - a. Voltmeter
    - b. Ampmeter

VALUE/ATTITUDE CONCEPTS: Awareness of safety practices when working with electrical circuits.

TASK AREA: Electrical

TASK #49: Repairs solenoid unit.

COMPETENCY: Perform electrical test to determine malfunction and repair solenoid unit to conform to manufacturer's specifications.

CRITERION: Can use proper test equipment and follow procedures to determine operating condition or malfunction of solenoid unit.

Can make repairs to unit and check to assure performance to specifications.

SKILL/PROCESS:

1. Test solenoid unit on vehicle
    a. Select proper test equipment
    b. Compare test results to manufacturer's specifications
2. Removal of solenoid unit
    a. Disconnect battery cables
    b. Identify wires and cables to solenoid
    c. Remove solenoid unit
3. Repairing solenoid unit
    a. Disassemble unit and clean with recommended material
    b. Test coil unit
    c. Replace defective parts
    d. Adjust contact plate
    e. Assemble unit and test to assure performance to specification

KNOWLEDGE/THEORY:

1. Function of solenoids
2. Principles of electricity and magnetism
    a. Voltage
    b. Amperage
    c. Resistance
    d. Electromagnetic fields
3. Function of solenoids components
    a. Coil windings
    b. Contact plate and lugs
    c. Plungers
4. Techniques of testing solenoids
    a. Voltage drop test
    b. Continuity and resistance test
5. Function of test equipment
    a. Voltmeter
    b. Ohmmeter
6. Techniques of wire identification
    a. Color code
    b. Numerical code
7. Techniques of solenoid repair
    a. Electrical parts
        (1) Soil
        (2) Contact surfaces
    b. Mechanical parts
        (1) Plunger

(2) Contact surfaces
(3) Contact plate depth

VALUE/ATTITUDE CONCEPTS: Awareness of safety practices when working with electrical circuits.

TASK AREA: Electrical

TASK #50: Repairs series-parallel solenoid unit.

COMPETENCY: Perform electrical test to determine malfunction of series-parallel solenoid units and repairs solenoid unit to conform to manufacturer's specifications.

CRITERION: Can use appropriate test equipment to determine condition of series-parallel units and compare test results with manufacturer's specification.

Can identify and make recommendations on necessary repairs.

Can replace parts or make repairs and test unit to check for performance to specifications.

SKILL/PROCESS:

1. Select test equipment
2. Perform tests and make determination of malfunction and needed repairs
3. Disassemble and clean unit with proper cleaning material
4. Test component parts
5. Assemble unit with needed replacement parts
6. Adjust contact plate to specifications
7. Test unit to check for performance to specification

KNOWLEDGE/THEORY:

1. Function of series-parallel units
2. Principles of electricity and magnetism
    a. Voltage
    b. Ampere
    c. Resistance
    d. Electromagnetic field
3. Components and functions - series-parallel units
    a. Coil windings
    b. Contact plate and lugs
    c. Plungers
    d. Insulators
    e. Points
    f. Circuit breakers
4. Techniques of testing series-parallel unit
    a. Voltage drop
    b. Continuity
    c. Resistance
5. Techniques of series-parallel solenoid repair
    a. Cleaning material
    b. Electrical parts
        (1) Coils
        (2) Contact surfaces
        (3) Insulators
    c. Mechanical parts
        (1) Plunger
        (2) Contact surfaces
        (3) Contact plate depth

VALUE/ATTITUDE CONCEPTS: Awareness of safety practices when working with electrical circuits.

TASK AREA: Servicing.

TASK #51: Services air starter motor.

COMPETENCY: Inspect, test, and service air starter motor to insure proper operation and starting of the engine.

CRITERION: Can check air starter for air leaks.

Can lubricate air starter using correct lubricants.

Can drain air tank of water.

SKILL/PROCESS:

1. Apply air to starter and check for leaks and proper engagement
2. Select correct lubricants
3. Lubricate air starter to manufacturer's specifications
4. Clean air lines and drain tank of water

KNOWLEDGE/THEORY:

1. Function of starters
2. Principles of air motors
   (a) Air flow and pressure
   (b) Vane motor operation
   (c) Control valve
   (d) Muffler
3. Test operation
   (a) Drive engagement
   (b) Valve operation
   (c) Motor performance
   (d) Muffler performance
4. Service starter
   (a) Lubricate vane motor with Marvel Mystery Oil
   (b) Drain air tank

VALUE/ATTITUDE CONCEPTS: Awareness of importance of servicing to provide preventative maintenance.

TASK AREA: Electrical

TASK #51A: Rebuilds air starter motor.

COMPETENCY: Rebuild air starter motor and test to assure performance according to manufacturer's specifications.

CRITERION: Can disassemble starter motor following correct safety procedures.

Can check bushings and bearings for wear and determine need for replacement.

Can check air motor for wear and determine need for replacement of vanes, rotor, and housing.

Can correctly reassemble, adjust, and test starter to assure performance to manufacturer's specifications.

SKILL/PROCESS:

1. Disassemble starter and clean parts
2. Check bushings and bearings for wear
3. Check air motor components for wear
4. Evaluate inspection results and make decision on replacement of parts
5. Reassemble, adjust, and test starter

KNOWLEDGE/THEORY:

1. Function of starters
2. Principles of air motors
    a. Air flow and pressure
    b. Vane motor operation
    c. Control valve
3. Component function and cleaning
    a. Housing (cam ring)
    b. Rotor and vanes
    c. Reduction gears
    d. Starter drive
    e. Bushings and bearings
4. Reassembly techniques
    a. Lubricate vanes
    b. Lubricate reduction gears
    c. Lubricate bearings and bushings

VALUE/ATTITUDE CONCEPTS: Awareness of the precision workmanship in rebuilding air starter assembly.

TASK AREA: Electrical

TASK #52: Tests DC generators on vehicle.

COMPETENCY: Perform electrical test to determine functioning of DC generator system and compare test results with specifications to determine needed servicing.

CRITERION: Can select and install proper test equipment.

Can perform test to determine generator output and condition and record test results.

Can make recommendation as to needed repairs by comparing test results with manufacturer's specifications.

SKILL/PROCESS:

1. Select test equipment and install to generator
2. Secure vehicle to run engine
3. Test generator for output and record results
4. Recommend needed repairs and compare test results with manufacturer's specifications

KNOWLEDGE/THEORY:

1. Function of DC generator
2. Principles of electricity
    a. Amperage
    b. Voltage
    c. Resistance
3. Principles of batteries
    a. Construction
    b. Chemical action
    c. Charging voltage
        (1) CEMF (counter-electro-motor-force)
        (2) Internal resistance (IR_b)
4. Methods of testing batteries
    a. Specific gravity
    b. Load test
    c. Internal resistance test
5. Types of DC generators
    a. Shunt type
        (1) "A" circuit
        (2) "B" circuit
    b. 3rd brush
    c. Split field
    d. Interpole
    e. Bucking field
6. Function of test equipment
    a. Voltmeter
    b. Ampmeter
    c. Carbon pile
    d. Fix resistor
7. Techniques of testing generators
    a. Current output
    b. Voltage output
8. Techniques of securing vehicle
    a. Transmission
    b. Brakes

c. Cab jacks and safety latches
d. Wheel chocks

VALUE/ATTITUDE CONCEPTS: Awareness of all safety factors in working with electricity and in conducting test under operating conditions.

TASK AREA: Electrical

TASK #53: Removes and replaces DC generator.

COMPETENCY: Remove, replace, and test operation of DC generator to assure proper functioning.

CRITERION: Can remove generator following correct procedures to assure identity of wires and replacement parts.

Can replace the generator following correct procedures and making proper wiring connections.

Can align pulleys and adjust for correct belt tensions.

Can polarize DC generators in accordance to manufacturer's procedures.

Can test generator to determine if replacement generator is performing to recommended specifications.

SKILL/PROCESS:

1. Remove generator following correct procedures
2. Identify wires and parts for replacement
3. Replace generator with correct procedures
4. Hook up wires making sure of connection
5. Check alignment of pulleys and adjust belt tension
6. Polarize generator according to manufacturer's procedures
7. Select proper test equipment and determine if generator is performing to specification

KNOWLEDGE/THEORY:

1. Function of DC generator
2. Principles of electricity and electromagnetism
    a. Voltage
    b. Amperage
    c. Resistance
    d. Magnetic fields
3. Types of generators
    a. Shunt type
        (1) "A" type circuit
        (2) "B" type circuit
    b. 3rd brush
    c. Split field
    d. Interpole
    e. Bucking field
4. Methods of generator mountings
    a. Mounting bolts
    b. Mounting brackets
    c. Belt tension adjustors
5. Types of generator drives
    a. Belts
        (1) Sheaves
        (2) Alignment
        (3) Tension
    b. Gear
        (1) Lash
        (2) Depth

   - c. Coupling
      - (1) Alignment
      - (2) Spacing
6. Techniques of polarizing
   - a. Internal grounded field
   - b. External grounded field
7. Method of checking output of generator
   - a. Electrical test units
      - (1) Voltmeter
      - (2) Ampmeter
      - (3) Carbon pile
   - b. Specifications
      - (1) Specified rpm
      - (2) Amp/volt ratings

VALUE/ATTITUDE CONCEPTS: Awareness of all safety factors in working with electricity and in conducting test under operating conditions.

TASK AREA: Electrical

TASK #54: Rebuilds DC generator.

COMPETENCY: Rebuild DC generator to conform to manufacturer's specifications.

CRITERION: Can properly disassemble generator.

Can perform electrical test using appropriate equipment to determine serviceability of each component.

Can check bushing and bearings for wear and determine need for replacement and perform repairs.

Can turn armature and undercut to manufacturer's specifications.

Can reassemble and test to determine if unit functions to manufacturer's specifications.

SKILL/PROCESS:

1. Disassemble generator and clean parts
2. Use appropriate test equipment to check armature, fields, and brush holders
3. Check bushings and bearings for wear
4. Evaluate test results to determine need for repair or replacement of parts
5. Machine commutator and undercut mica
6. Reassemble generator and test to determine if unit functions to manufacturer's specifications

KNOWLEDGE/THEORY:

1. Function of DC generator
2. Principles of electricity and electromagnetism
   a. Voltage
   b. Amperage
   c. Resistance
   d. Magnetic field
3. Types of DC generators
   a. Shunt type
      (1) "A" type circuit
      (2) "B" type circuit
   b. 3rd brush
   c. Split field
   d. Interpole
   e. Bucking field
4. DC generator components, function, cleaning and testing
   a. Electrical components
      (1) Field coils
      (2) Armature
      (3) Brushes and holders
      (4) Insulators
   b. Electrical test equipment
      (1) Voltmeter
      (2) Ampmeter
      (3) Ohmmeter
      (4) Test light

            - (5) Growler
        - c. Mechanical components
            - (1) Housing
            - (2) Bearings and lubrication
            - (3) Drive mechanism
                - (a) Belt
                - (b) Gear
                - (c) Coupling
            - (4) Commutator trueness and surface characteristics
- 5. Electrical tests
    - a. Open circuits
    - b. Ground circuits
    - c. Shorted circuits
    - d. Output test
- 6. Mechanical checks
    - a. Bushing and bearing wear
    - b. Clearances
    - c. Brushes and spring tension

VALUE/ATTITUDE CONCEPTS: Awareness of all safety factors in working with electricity and in conducting test under operating conditions.

TASK AREA: Electrical

TASK #55: Tests and adjusts DC regulators.

COMPETENCY: Test regulator on vehicle equipped with DC charging system and adjust so battery has minimal water usage and correct specific gravity.

CRITERION: Can hook up appropriate test equipment and determine regulator cut in and cut out for current and voltage settings.

Can use manufacturer's specifications to evaluate test results and determine if regulator needs adjusting.

Can adjust contacts in regulator so battery has minimal water usage and correct specific gravity.

SKILL/PROCESS:

1. Select proper tools
2. Select test equipment and hook up to charging system
3. Select test data for regulators
4. Secure vehicle to run engine
5. Perform test and adjustments for minimal water usage and specific gravity
   a. Generator output
   b. Reverse current cutout relay
   c. Voltage setting
   d. Current setting

KNOWLEDGE/THEORY:

1. Function of DC regulators
   a. Generator protection
   b. Voltage control
2. Principles of electricity and electromagnetism
   a. Voltage
   b. Amperage
   c. Resistance
   d. Magnetic fields
3. Function of regulator units
   a. Reverse current cut-out relay
      (1) Construction
      (2) Adjustments
   b. Voltage control unit
      (1) Construction
      (2) Adjustments
   c. Amperage control unit
4. Principles of batteries
   a. Construction
   b. Chemical action
   c. Charging voltages
      (1) CEMF
      (2) Internal resistance (IR_b)
5. Techniques of testing and adjusting
   a. Reverse current cut out relay
      (1) Closing voltage
      (2) Opening current

    - b. Voltage control unit - maximum voltage setting
    - c. Current control unit - maximum current setting
6. Function of test equipment
    - a. Voltmeter
    - b. Ampmeter
    - c. Carbon pile
    - d. Field control
    - e. Fixed resistor

VALUE/ATTITUDE CONCEPTS:

Awareness of all safety factors in working with electricity and in conducting test under operating conditions.

Awareness of proper regulator adjustment for maximum generator and battery life.

TASK AREA: Electrical

TASK #56: Removes and replaces DC regulator.

COMPETENCY: Remove and replace DC regulator and adjust to correct amperage and voltage to maintain minimal battery water usage and correct specific gravity.

CRITERION: Can remove DC regulator following correct procedures and identify wires and connections for replacing.

Can select and install replacement DC regulator following correct procedures.

Can select proper test equipment, make test and adjust regulator to maintain minimal battery water usage and correct specific gravity.

SKILL/PROCESS:

1. Remove ground wire from battery
2. Remove wires from regulator and label for identification
3. Remove regulator and replace with compatible unit
4. Use appropriate test equipment to check current and voltage settings
5. Adjust air gaps in regulator if needed

KNOWLEDGE/THEORY:

1. Methods of wire identification
   a. Numbering
   b. Color coding
2. Principles of electricity and electromagnetism
   a. Voltage
   b. Amperage
   c. Resistance
   d. Magnetic fields
3. Function of regulator units
   a. Reverse current cut-out relay
      (1) Construction
      (2) Adjustments
   b. Voltage control unit
      (1) Construction
      (2) Adjustments
   c. Amperage control unit
4. Principles of batteries
   a. Construction
   b. Chemical action
   c. Charging voltages
      (1) CEMF
      (2) Internal resistance (IR_b)
5. Techniques of testing and adjusting
   a. Reverse current cut out relay
      (1) Closing voltage
      (2) Opening current)
   b. Voltage control unit - maximum voltage setting
   c. Current control unit - maximum current setting

6. Function of test equipment
    a. Voltmeter
    b. Ampmeter
    c. Carbon pile
    d. Field control
    e. Fixed resistor

VALUE/ATTITUDE CONCEPTS:

Awareness of all safety factors in working with electricity and in conducting test under operating conditions.

Awareness of proper regulator adjustment for maximum generator and battery life.

TASK AREA: Electrical

TASK #57: Tests alternator on vehicle.

COMPETENCY: Perform electrical test to determine functioning of alternator and compare test results with specifications to determine needed servicing.

CRITERION: Can hook up appropriate test equipment and test alternator voltage and current output.

Can compare test results with manufacturer's specifications and evaluate alternator performance and make recommendations on needed servicing.

SKILL/PROCESS:

1. Select test equipment
2. Check specific gravity and load test battery
3. Secure vehicle to run engine
4. Hook up test equipment and start engine
5. Perform test to determine voltage and amperage, output, or settings
6. Compare test results with manufacturer's specifications and recommended needed servicing

KNOWLEDGE/THEORY:

1. Function of alternators
2. Principles of electricity
    a. Amperage
    b. Voltage
    c. Resistance
3. Principles of batteries
    a. Construction
    b. Chemical action
    c. Charging voltage
        (1) CEMF
        (2) Internal resistance (IR_b)
4. Methods of testing batteries
    a. Specific gravity
    b. Load test
    c. Internal resistance test
5. Function of test equipment
    a. Voltmeter
    b. Ampmeter
    c. Carbon pile
    d. Fix resistor
6. Techniques of testing alternators
    a. Current output
    b. Voltage settings
7. Techniques of securing vehicle
    a. Transmission
    b. Brakes
    c. Cab jacks and safety latches
    d. Wheel chocks

VALUE/ATTITUDE CONCEPTS: Awareness of all safety factors in working with electricity and in conducting test under operating conditions.

TASK AREA: Electrical

TASK #58: Removes and replaces alternator.

COMPETENCY: Remove, replace, and test alternator to assure proper functioning.

CRITERION: Can disconnect cables from battery and remove alternator from engine.

Can install alternator on engine with wires properly connected.

Can align belt, pulleys and adjust belt tension to manufacturer's specifications.

Can connect appropriate test equipment and determine if alternator output is within specifications.

SKILL/PROCESS:

1. Remove cables from battery
2. Identify wires and remove alternator
3. Select alternator and install with wires properly connected
4. Check alignment of belts and pulleys and adjust to manufacturer's specifications
5. Start engine; use test equipment to determine alternator output

KNOWLEDGE/THEORY:

1. Methods of wire identification
    a. Numbering
    b. Color coding
2. Methods of alternator mounting
    a. Mounting bolts
    b. Mounting brackets
    c. Belt tension adjustors
3. Types of alternator drives
    a. Belts
        (1) Sheaves
        (2) Alignment
        (3) Tension
    b. Gear
        (1) Gear lash
        (2) Gear depth
    c. Coupling
        (1) Alignment
        (2) Spacing
4. Function of alternators
5. Principles of electricity
    a. Amperage
    b. Voltage
    c. Resistance
6. Principles of batteries
    a. Construction
    b. Chemical action
    c. Charging voltage
        (1) CEMF
        (2) Internal resistance (IR_b)

7. Methods of testing batteries
    a. Specific gravity
    b. Load test
    c. Internal resistance test
8. Function of test equipment
    a. Voltmeter
    b. Ampmeter
    c. Carbon pile
    d. Fix resistor
9. Techniques of testing alternators
    a. Current output
    b. Voltage settings
10. Techniques of securing vehicle
    a. Transmission
    b. Brakes
    c. Cab jacks and safety latches
    d. Wheel chocks

VALUE/ATTITUDE CONCEPTS: Awareness of all safety factors in working with electricity and in conducting test under operating conditions.

TASK AREA: Electrical

TASK #59: Rebuilds alternator.

COMPETENCY: Rebuild alternator and test to assure functioning to manufacturer's specifications.

CRITERION: Can properly disassemble alternator.

Can select proper electrical test equipment and perform electrical test.

Can select proper measurement instruments and determine serviceability of parts.

Can test bearings for replacement.

Can make needed electrical and mechanical repairs.

Can assemble and test completed unit to assure functioning to manufacturer's specifications.

SKILL/PROCESS:

1. Disassemble alternator and clean parts
2. Use appropriate test equipment and check rotor, stator, diodes and brush holders, insulators, and capacitor
3. Check bearings for wear
4. Visually check for housing damage or wear
5. Evaluate test data and determine need for repair or replacement of parts
6. Make needed repairs
7. Properly lubricate bearings
8. Reassemble alternator and test operation

KNOWLEDGE/THEORY:

1. Function of alternators
2. Principles of electricity and electromagnetism
    a. Voltage - AC and DC
    b. Amperage
    c. Resistance
    d. Magnetic field
3. Principles of semi-conductors
    a. Diodes
    b. Transistors
4. Types of alternator
    a. Internal rectification
    b. External rectification
    c. Brush type
    d. Brushless type
5. Alternator components, function, cleaning, and testing
    a. Electrical components
        (1) Rotor
        (2) Stator
        (3) Brushes and holders
        (4) Diodes and heat sinks
        (5) Insulators
        (6) Capacitors
    b. Electrical test equipment
        (1) Ampmeter

        - (2) Voltmeter
        - (3) Ohmmeter
        - (4) Test light
        - (5) Diode testers
    - c. Mechanical components
        - (1) Housing
        - (2) Bearings and lubrication
        - (3) Drive mechanism
        - (4) Slip ring trueness and surface characteristics
- 6. Electrical tests
    - a. Open circuits
    - b. Ground circuits
    - c. Shorted circuits
    - d. Output test

VALUE/ATTITUDE CONCEPTS:

Awareness of all safety factors in working with electricity and in conducting test under operating conditions.

TASK AREA: Electrical

TASK #60: Tests and adjusts alternator voltage regulator on vehicle.

COMPETENCY: Test voltage output of the alternator voltage regulator of vehicle equipped with adjustable voltage regulator and adjust voltage to assure battery has minimal water usage and proper specific gravity.

CRITERION: Can secure vehicle for safe performance testing of alternator.

Can select appropriate test equipment and install to manufacturer's recommendations.

Can perform voltage setting test and adjust if needed to assure battery has minimal water usage and proper specific gravity.

SKILL/PROCESS:

1. Select proper test equipment
2. Secure vehicle to run engine
3. Hook up test equipment
4. Check battery specific gravity and load test to assure voltage setting can be made
5. Start engine and adjust to proper rpm
6. Adjust voltage setting to assure battery has minimal usage and maintain proper specific gravity

KNOWLEDGE/THEORY:

1. Function of voltage regulators
   a. Control voltage
   b. Reason to control voltage
      (1) Specific gravity
      (2) Water usage
2. Principles of electricity and electromagnetism
   a. Voltage
   b. Amperage
   c. Resistance
   d. Magnetic field
3. Principles of regulators
   a. Vibrating point
      (1) Construction
      (2) Adjustments
   b. Semi-conductors
      (1) Construction
      (2) Adjustment
4. Principles of batteries
   a. Construction
   b. Chemical action
   c. Charging voltages
      (1) CEMF
      (2) Internal resistance (IR_b)
5. Methods of testing batteries
   a. Specific gravity
   b. Load test
   c. Internal resistance test
6. Function of test equipment

    - a. Voltmeter
    - b. Ampmeter
    - c. Carbon pile
    - d. Fix resistor
7. Techniques of testing alternator regulators
8. Techniques of securing vehicle
    - a. Transmission
    - b. Brakes
    - c. Cab jacks and safety latches
    - d. Wheel chocks

VALUE/ATTITUDE CONCEPTS:

Awareness of all safety factors in working with electricity and in conducting test under operating conditions.

Awareness of adjustment specification to maximum battery life.

TASK AREA: Electrical

TASK #61 Repairs and tests alternator voltage regulator.

COMPETENCY: Repair, test vibrating point voltage regulator, and adjust to manufacturer's specifications.

CRITERION: Can clean and adjust point gap for proper operation.

Can test and replace resistors.

Can locate and repair defective wiring connections.

Can use appropriate test equipment and determine if voltage setting meets manufacturer's specification.

Can adjust voltage setting to manufacturer's specifications.

SKILL/PROCESS:

1. Select test equipment
2. Remove cover for cleaning, testing, and adjusting
3. Clean points properly with file
4. Visually inspect for damage
5. Test resistors for continuity and repair as necessary
6. Adjust armature air gaps to specifications
7. Adjust point air gap on field relay
8. Bench test and adjust to manufacturer's specifications for voltage setting

KNOWLEDGE/THEORY:

1. Function of alternator voltage regulators
2. Principles of electricity and electromagnetism
    a. Voltage
    b. Amperage
    c. Resistance
    d. Magnetic field
3. Function of regulator units
    a. Field relay
        (1) Construction
        (2) Adjustments
    b. Voltage control unit
        (1) Construction
        (2) Adjustments
4. Function of test equipment
    a. Voltmeter
    b. Ampmeter
    c. Fix resistor
    d. Variable resistor
5. Techniques of testing and adjusting
    a. Field relay - closing voltage
    b. Voltage control - voltage setting

VALUE/ATTITUDE CONCEPTS: Awareness of all safety factors in working with electricity and in conducting test under operating conditions.

Awareness of adjustment specification to maximum battery life.

TASK AREA: Electrical

TASK #61A: Repairs and tests transistor voltage regulator.

COMPETENCY: Repair, test transistor voltage regulator unit, and adjust to manufacturer's specifications.

CRITERION: Can properly disassemble voltage regulator.

Can select appropriate test equipment and test component parts.

Can properly remove defective parts.

Can select and install new parts as recommended by manufacturer.

Can correctly reassemble unit, test and adjust to manufacturer's specifications.

SKILL/PROCESS:

1. Select test equipment
2. Disassemble regulator following manufacturer's procedures
3. Test and remove defective components following manufacturer's recommendations
    a. Diodes
    b. Zenors
    c. Transistors
    d. Capacitors
    e. Potentiometer
    f. Resistors
4. Reassemble unit with new parts as needed, following recommended procedures by manufacturer
5. Test and adjust assembled unit to manufacturer's recommended setting

KNOWLEDGE/THEORY:

1. Function of voltage regulators
2. Principles of electricity and electromagnetism
    a. Voltage
    b. Amperage
    c. Resistance
    d. Magnetic fields
3. Function of regulator components and testing
    a. Diodes
    b. Zenors
    c. Transistors
    d. Capacitors
    e. Potentiometers
    f. Resistors
4. Function of test equipment
    a. Voltmeter
    b. Ampmeter
    c. Ohmmeter
    d. Fix resistor
    e. Variable resistor
    f. Diode testers
    g. Transistor testers

5. Techniques of testing and adjusting

VALUE/ATTITUDE CONCEPTS:

Awareness of all safety factors in working with electricity and in conducting test under operating conditions.

Awareness of proper polarity when testing.

TASK AREA: Electrical

TASK #62: Removes and replaces electrical relay.

COMPETENCY: Remove and install relay and test to determine proper functioning.

CRITERION: Can identify wires for proper installation.

Can properly remove and select replacement relay and install.

Can select and hook up test equipment to determine proper functioning of relay according to manufacturer's specifications.

SKILL/PROCESS:

1. Identify wires and remove electrical relay
2. Install replacement relay and wires for proper connection
3. Select test equipment and determine if functioning according to manufacturer's specifications

KNOWLEDGE/THEORY:

1. Function of electric relay units
2. Principle of electricity and magnetism
    a. Voltage
    b. Ampere
    c. Resistance
    d. Electromagnetic field
3. Function of electric-relay units components
    a. Armature
    b. Coil
    c. Contacts
4. Techniques of wire identification
    a. Color coding
    b. Numerical coding
5. Techniques of testing electrical relay
    a. Test light
    b. Voltage drop

VALUE/ATTITUDE CONCEPTS: Awareness of all safety factors in working with electricity and in conducting test under operating conditions.

TASK AREA: Electrical

TASK #63: Removes, replaces or repairs turn signal unit.

COMPETENCY: Determine malfunction and make necessary decision as to need for replacing or repairing unit and perform maintenance to correct malfunction.

CRITERION: Can use visual methods and test instruments to locate malfunction in turn signal.

Can select correct replacements parts and/or repair technique to repair unit.

Can check signal system to assure repairs are made and unit is functioning.

SKILL/PROCESS:

1. Observe all lights for functioning
2. Use test light or meter to locate source of malfunction
3. Remove turn signal unit from steering column if necessary
4. Disassemble unit and repair if appropriate
5. Replace signal unit with new part if appropriate
6. Observe all lights to determine correct functioning

KNOWLEDGE/THEORY:

1. Function of turn signals
2. Principles of turn signals units
    a. Integral unit (self cancellation)
    b. External mounted
    c. Flasher unit
3. Principles of electricity
    a. Voltage
    b. Amperage
    c. Resistance
4. Functions of test equipment
    a. Test light
    b. Voltmeter
    c. Ampmeter
    d. Ohmmeter
5. Techniques of testing and repair or replacement
    a. Troubleshooting
    b. Removal and disassembly
        (1) Integral
        (2) External
        (3) Replacement of parts
        (4) Installation
        (5) Replacement of complete unit
            (a) Turn lights only
            (b) Turn lights and brake lights

VALUE/ATTITUDE CONCEPTS: Awareness of safety practices in working with electrical circuits.

TASK AREA: Electrical

TASK #64: Rewires "7" way trailer plug and cord.

COMPETENCY: Make repairs on "7" way plug and cord and test for operation.

CRITERION: Can use appropriate test equipment to check wiring connections on tractor and trailer.

Can disassemble and reassemble trailer cord plugs without damage to wires.

Can identify and connect wires in proper color coded pattern.

Can follow wiring diagrams or identification marks for "7" way trailer plug and cord.

Can use test equipment to identify each circuit and connect wire to proper terminal according to connector manufacturer's specification to assure a mechanically and electrically sound connection.

Can test electrical lighting system to assure all lights function according to specification.

SKILL/PROCESS:

1. Select appropriate test equipment for checking wiring on tractor-trailer
2. Disassemble trailer plug without wire damage
3. Using test equipment, identify each circuit for proper terminal wiring
4. Wire plugs with proper color coded pattern
5. Check wiring for mechanically and electrically sound connections
6. Test lighting systems to assure proper operation

KNOWLEDGE/THEORY:

1. Function of trailer plug and cord
2. Principles of "7" way trailer plug and cord
    a. Stoplight
        (1) Position
        (2) Color code
    b. Marker lights
        (1) Position
        (2) Color code
    c. Turn signal
        (1) Position
        (2) Color code
    d. Grounding circuit
        (1) Position
        (2) Color codes
    e. Auxiliary circuit
        (1) Position
        (2) Color code
3. Principles of electricity
    a. Voltage
    b. Amperage
    c. Resistance

4. Techniques of testing plug and cords
    a. Test light
    b. Voltmeter
    c. Ohmmeter
5. Techniques of repairing trailer plug and cords
    a. Disassembly
    b. Wire and terminal connections
        (1) "Tinning"
        (2) Soldering
        (3) Compression fittings (solderless)
    c. Assembly
        (1) Wire positioning
        (2) Color coding
        (3) Insulation

VALUE/ATTITUDE CONCEPTS:

Awareness of safety practices in working with electrical circuits.

Awareness of the use of proper wiring code for future maintenance.

TASK AREA: Electrical

TASK #65: Removes and replaces dash switches and gauges.

COMPETENCY: Test to determine malfunction of switches and gauges and remove and replace malfunctioning component and test to determine proper operation.

CRITERION: Can read circuit diagrams and use appropriate test instruments to test switches and gauges to determine malfunctioning unit.

Can identify malfunctioning unit by comparing test results with specifications.

Can properly identify wires for replacement of units.

Can properly remove unit and select proper replacement and install to manufacturer's specifications.

SKILL/PROCESS:

1. Use test light or meter to isolate defective switch or gauge
2. Identify wires for proper reassembly and remove defective part
3. Select correct replacement and install new part
4. Check operation of circuit to assure proper operation of replaced component

KNOWLEDGE/THEORY:

1. Function of switches and gauges
   a. Light switches
   b. On-off switches
   c. Temperature gauges
   d. Voltage gauge
   e. Amp gauge
   f. Fuel gauge
   g. Fuses
   h. Circuit breakers
2. Principles of electricity
   a. Voltage
   b. Amperage
   c. Resistance
3. Function of wiring diagrams
   a. Routing
   b. Coding
   c. Component function
4. Function of test equipment
   a. Test light
   b. Ohmmeter
   c. Voltmeter
   d. Ampmeter
5. Techniques of removal and replacement of gauges and switches
   a. Wire identification

b. Component matching
c. Wire routing
d. Component mounting

VALUE/ATTITUDE CONCEPTS:

Awareness of safety practices in working with electrical circuits.

Awareness of hazards of wearing jewelry when working in dash area.

TASK AREA: Electrical

TASK #66: Troubleshoots and repairs electrical lighting systems.

COMPETENCY: Troubleshoot electrical lighting system using test instruments and visual check to identify and isolate malfunction and make repair using correct techniques, materials, and replacement parts so that system operates smoothly.

CRITERION: Can read circuit diagrams and use test instruments to troubleshoot circuits to locate and determine lighting malfunction.

Can visually check to locate malfunctions, wire and connection wear and damage and make decision on needed repair or part replacement.

Can repair damaged or worn part or component to restore to correct operating mode.

SKILL/PROCESS:

1. Visually check lighting system to isolate malfunctioning lights
2. Check fuse and replace with correct fuse
3. Check bulb and replace damaged or burned out bulb correctly
4. Check wiring harnesses and wiring for damage.
5. Replace or repair wiring and wiring harnesses
6. Use test instrument to check wiring continuity
7. Use test instrument to check voltage
8. Check for rust on lamps and clean or replace lamp
9. Check signal switch and wiring harness and make decision on repair or replacement
10. Check lighting switches and replace damaged switches
11. Check brake light control switch and replace and/or adjust

KNOWLEDGE/THEORY:

1. Function of electrical lighting systems
2. Principles of electricity
    a. Voltage
    b. Amperage
    c. Resistance
3. Principles of electric light bulbs
    a. Power
    b. Construction
    c. Design
4. Principles of wiring
    a. Color coding
    b. Numerical coding
    c. Wire size
    d. Wire insulation
5. Function of test equipment
    a. Test light
    b. Ohmmeter

    c. Voltmeter
    d. Ampmeter
6. Function of wiring diagrams
    a. Location
    b. Component function
    c. Coding
    d. Wire size
7. Function of lighting systems
    a. Heat lights
    b. Marker light
    c. Turn signals
    d. Brake lights
    e. Dash lights
    f. Interior lights
8. Techniques of testing lighting circuits
    a. Visual
    b. Test light
    c. Voltmeter
    d. Ampmeter

VALUE/ATTITUDE CONCEPTS: Awareness of safety practices in working with electrical circuits.

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TASK AREA: Chassis and Suspension

TASK #67: Services wheel bearings and seals.

COMPETENCY: Service wheel bearings and seals to inspect for wear and replace, lubricate, install, and adjust to manufacturer's recommendations.

CRITERION: Can remove tire, wheel and hub assembly.

Can properly clean bearings and hubs.

Can inspect and make recommendations for reuse or replacement.

Can identify bearing and seal numbers and select proper replacement parts.

Can select proper lubrication and method of application.

Can properly install, add components, and adjust to manufacturer's specifications.

SKILL/PROCESS:

Front Wheel:

1. Secure vehicle
2. Raise vehicle front end off floor to remove wheels
3. Loosen brake adjustment or remove disc brake caliper
4. Remove wheel and hub assembly
5. Remove bearings and seals
6. Clean and inspect bearings, hub, and spindle for damage
7. Replace bearings with correct replacement if damaged
8. Replace grease seals using proper tools
9. Lubricate bearings with correct lubricant
10. Replace hub and wheel assembly and proper external covers
11. Adjust (core) bearing
12. Fill oil lubricated bearings with correct oil
13. Replace disc caliper or adjust brake shoes
14. Check for proper installation

Rear Wheel:

1. Secure vehicle for raising rear wheels
2. Raise rear wheels off floor
3. Loosen brake adjustment
4. Remove axle
5. Remove hub and wheel assembly
6. Remove seals
7. Remove bearings
8. Inspect bearings, hubs, and axle tubes for damage
9. Replace damaged bearings

10. Lubricate bearing and surfaces
11. Replace seals
12. Replace hub and wheel assembly
13. Adjust bearing
14. Install axle
15. Adjust brakes
16. Check for proper installation

KNOWLEDGE/THEORY:

1. Function of wheel bearing and assembly
    a. Reduce friction
    b. Support wheel to spindle
    c. Seals
2. Type of wheel bearings - taper roller
3. Types of seals
4. Lubrication and effect
    a. Grease types
    b. Oil types
5. Techniques for removal of wheels
    a. Oil type
    b. Grease type
6. Techniques for removal of bearings and seals
7. Techniques for inspection and packing wheel bearing
8. Factors affecting assembly of bearing and seals
    a. Bearing preload
    b. Lubrication
    c. Wear ring

VALUE/ATTITUDE CONCEPTS: See general list on Page 11.

TASK AREA: Chassis and Suspension

TASK #68: Installs and trues tire and rim assembly on spoke wheels.
(Caution: Safety - Tire and rim mounted not by mechanic)

COMPETENCY: Install tire and rim assembly on spoke wheels and true to 1/4 inch lateral run-out using correct procedures.

CRITERION: Can place tire and rim assembly in spoke wheel using correct spacer for duals.

Can install clamps and nuts and adjust tire to attain 1/4 inch maximum lateral run-out.

Can torque nuts in correct sequence.

SKILL/PROCESS:

1. Install tire and rim assembly on spoke wheel. If dual wheels, use correct width spacer
2. Install nuts and clamps and tighten evenly
3. Turn tire and wheel assembly to observe run-out
4. Alternately loosen and tighten clamp nuts to adjust lateral run-out to not more than 1/4 inch
5. Torque nuts to maximum value according to manufacturer's recommendations

KNOWLEDGE/THEORY:

1. Types of wheel assemblies
    a. Budd
    b. Disc
    c. Cast steel spoke
2. Function of cast steel spoke assembly
    a. Rim
    b. Spoke hub assembly
    c. Rim clamp
    d. Rim clamp nuts
    e. Rim spacer
3. Techniques of mounting front spoke wheels
    a. Cleaning
    b. Torquing
    c. Run-out
4. Techniques of mounting dual rims on spoke wheels
    a. Cleaning
    b. Spacing
    c. Torquing
    d. Run-out

VALUE/ATTITUDE CONCEPTS: Awareness of extreme danger in handling wheel with multipiece rims.

TASK AREA: Chassis and Suspension

TASK #69: Checks steering linkage.

COMPETENCY: Determine if any steering linkage is worn or unsafe by visual test and feel methods.

CRITERION: Can visually check component parts of steering linkage for excessive wear and looseness.

Can determine excessive wear in steering linkage by feeling loose motion in steering wheel.

SKILL/PROCESS:

1. Select proper tools
2. Visually check components for wear or looseness
3. Check components by moving:
   a. Tie-rod for looseness
   b. Drag link for looseness
   c. Steering box for looseness
   d. Pitman arm for wear or looseness

KNOWLEDGE/THEORY:

1. Function of steering linkage
   a. Tie-rod
   b. Drag link
   c. Steering box
   d. Pitman arm
2. Techniques of checking steering linkage
   a. Visual (excess movement of steering linkage)
   b. Feel method
      (1) Excess movement in steering wheel
      (2) Excess movement at linkage

VALUE/ATTITUDE CONCEPTS: Awareness of safety practices while working beneath vehicle.

Awareness of safety factors involved with steering systems.

TASK AREA: Chassis and Suspension

TASK #70: Rebuilds steering sector box.

COMPETENCY: Rebuild steering sector box by replacing parts and making adjustments to manufacturer's specifications.

CRITERION: Can properly disassemble and clean sector box.

Can determine worn or damaged parts.

Can select proper parts and replace to manufacturer's specifications.

Can make proper adjustment of bearings and sector to manufacturer's specifications.

SKILL/PROCESS:

1. Disassemble and clean sector box and parts
2. Measure or visually inspect parts as appropriate for excessive wear
3. Select correct replacement parts
4. Install new oil seal and reassemble worn shaft
5. Pre-load bearing
6. Reassemble and time sector
7. Adjust sector shaft lash on "high spot "

KNOWLEDGE/THEORY:

1. Principles of steering sector box
   a. Gear reduction mechanical advantage
   b. Bearings - ease of turning
   c. Change of motion - 90° angle
2. Types of steering sector boxes
   a. Recirculating ball and nut gear
   b. Worm and roller gear
   c. Cam and lever gear
3. Function of steering box components
   a. Cross shaft
   b. Cam
   c. Bearings
      (1) Thrust
      (2) Bushings
   d. Housing
4. Techniques of adjustments
   a. Cam
      (1) Shims
      (2) Adjusting plug
   b. Cross shaft
   c. Timing

VALUE/ATTITUDE CONCEPTS: Awareness of safety practices while working beneath vehicle.

Awareness of safety factors involved with steering systems.

Awareness of importance of proper assembly and torquing.

TASK AREA: Chassis and Suspension

TASK #71: Adjusts steering sector box on vehicle.

COMPETENCY: Correct and adjust vehicles with excessive "play" in steering box to manufacturer's specifications.

CRITERION: Can properly disconnect necessary component to measure bearing pre-load.

Can adjust bearings and sector to manufacturer's specifications.

Can properly reinstall components for safe operation.

SKILL/PROCESS:

1. Select proper tools
2. Disconnect drag link
3. Center steering wheel
4. Loosen locknut from lash or adjustor screw
5. Backout lash or adjustor screw unit play is observed between sector gear and worn gear
6. Turn steering wheel in one direction until it stops, back up one turn
7. Adjust worn gear bearing by removing shims or turning bearing adjustor until proper pre-load is obtained
8. Center steering gear by turning steering wheel stop-to-stop counting turns, come back half way
9. Tighten lash adjustor screw until proper torque or pull is found at steering wheel rim
10. Connect drag link

KNOWLEDGE/THEORY:

1. Function of steering sector box
    a. Gear reduction mechanical advantage
    b. Bearings - ease of turning
    c. Change of motion - 90° angle
2. Types of steering sector boxes
    a. Recirculating ball and nut gear
    b. Worm and roller gear
    c. Cam and lever gear
3. Techniques of sector box adjustment
    a. Cam
        (1) Shims
        (2) Adjusting plug
    b. Cross shaft

VALUE/ATTITUDE CONCEPTS:

Awareness of safety practices while working beneath vehicle.

Awareness of safety factors involved with steering systems.

Awareness of importance of proper assembly and torquing.

TASK AREA: Chassis and Suspension

TASK #72: Repairs and/or adjusts drag link.

COMPETENCY: Test conditions of drag link and determine need to repair or adjust drag link to eliminate free movement.

CRITERION: Can check drag link balls and ball sockets for loose motion.

Can determine need to straighten and can straighten bent drag link.

Can adjust and relubricate loose drag link ends.

SKILL/PROCESS:

1. Remove cotter pin
2. Remove adjusting plug and bearings, spring, and seal
3. Clean parts and inspect
4. Reassemble parts in proper order
5. Install drag link on vehicle
6. Turn adjust plug until solid resistance is encountered about 50 to 60 pounds full torque
7. Back adjusting plug out to first position in which cotter pin hole in drag link lines up with slot in adjusting plug
8. Install cotter pin
9. Lubricate drag link

KNOWLEDGE/THEORY:

1. Function of drag link
2. Types of drag links
    a. Adjustable
    b. Non-adjustable
3. Drag link components
    a. Tube
    b. Ball and stud
    c. Ball seats
    d. Spring
    e. Safety plug
    f. End plug
4. Techniques of repairs to drag link
    a. Straightening
    b. Cleaning
    c. Inspection
        (1) Worn components
        (2) Damaged components
    d. Replacement
5. Methods of adjustment
    a. End plug elimination
    b. Torquing
6. Techniques of lubrication
    a. Types of lubricants
    b. Quantity

VALUE/ATTITUDE CONCEPTS: Awareness of safety practices while working beneath vehicle.

Awareness of safety factors involved with steering systems.

Awareness of importance of proper assembly and torquing.

TASK AREA: Chassis and Suspension

TASK #73: Removes, replaces, or repair tie-rods.

COMPETENCY: Determine needed repairs and make the repairs to correct steering problem so that no play will exist in tie-rod and proper toe-in will be re-established.

CRITERION: Can determine excessive wear and make recommendations on replacement and/or repair.

Can properly replace or repair worn unit.

Can properly adjust toe-in to manufacturer's specifications.

SKILL/PROCESS: Non-Adjustable or Integral:

1. Remove cotter pin
2. Remove nut
3. Using approved tool, disengage tie-rod from steering arms
4. Loosen clamp assembly on cross steering tube
5. Remove tie-rod assembly (count the turns to remove assembly and reinstall same number of turns)
6. Install new tie-rod assembly into cross-steering tube
7. Install tie-rod in steering arms, install nut and cotter pin
8. Reset toe-in

Adjustable-type:

1. Remove tie-rod from steering arms
2. Remove tie-rod from cross steering tube
3. Remove cotter pin or bolt from spring plug and turn plug until it seats on socket
4. Back spring plug out until holes line up, install cotter pin or bolt
5. Reinstall tie-rod in cross-steering tube
6. Reinstall tie-rod in steering arm, tighten nut and install cotter pin
7. Adjust toe-in

KNOWLEDGE/THEORY:

1. Function of tie-rod
    a. Flexible coupling
    b. Means of adjustment - toe-in
2. Techniques of wear determination
    a. Visual inspection
    b. Gauging
3. Types of tie-rods
    a. Adjustable
    b. Non-adjustable
    c. Left and right hand threads

4. Techniques of setting toe-in
    a. Scribe and measure
    b. Toe-in gauges
    c. Scuff gauges

VALUE/ATTITUDE CONCEPTS:

Awareness of safety practices while working beneath vehicle.

Awareness of safety factors involved with steering systems.

Awareness of importance of proper assembly and torquing.

TASK AREA: Chassis and Suspension

TASK #74: Removes and replaces steering shaft and bearings.

COMPETENCY: Remove and replace steering shaft and bearings, checking each part to determine wear and method of reconditioning for steering to function within recommended tolerances.

CRITERION: Can remove steering shaft between steering gear and column.

Can inspect splines for wear and properly replace u-joints.

Can remove steering column from vehicle.

Can replace bearings and spacers and adjust column steering shaft to manufacturer's specifications.

Can install components in vehicle with steering wheel properly centered.

SKILL/PROCESS:

1. Remove steering wheel column and shaft
2. Disassemble steering column
3. Clean and inspect parts for damage or wear
    a. Splines for wear
    b. Shaft bearing areas
    c. U-joints for wear
    d. Shaft bearings
4. Reassemble with serviceable or new parts
5. Lubricate with proper type and amount of lubricant
6. Adjust bearing and column to manufacturer's specification
7. Install steering wheel properly centered

KNOWLEDGE/THEORY:

1. Function of steering shaft
2. Types of steering shafts
    a. One-piece shaft
    b. Multiple shaft
3. Steering shaft components, function, cleaning, and replacement
    a. Couplers
        (1) Flexible
        (2) Keyed
        (3) Splined
    b. Bearings
        (1) Sleeve
        (2) Ball
    c. Center cross (u-joint)
    d. Steering shaft
4. Techniques of centering steering wheel
    a. Sector box centering
    b. Cross-shaft/Pitman arm location
5. Techniques of lubrication
    a. Type of lubricants
    b. Quantity
    c. Lubrication points

VALUE/ATTITUDE CONCEPTS:

Awareness of safety practices while working beneath vehicle.

Awareness of safety factors involved with steering systems.

Awareness of importance of proper assembly and torquing.

TASK AREA: Chassis and Suspension

TASK #75: Removes and replaces steering knuckle ball joint.

COMPETENCY: Remove and replace steering knuckle ball joints following recommended procedures and replacing with correct replacement parts.

CRITERION: Can properly and safely support vehicle and remove necessary components to replace knuckle ball joint.

Can properly remove and install knuckle ball joint following recommended procedures.

Can properly reinstall components and test for safe operation.

SKILL/PROCESS:

1. Using jack under front suspensions cross-member raise vehicle and support safely to remove hubs, wheels, and tires
2. Remove brake shoes, brake chambers, and slack adjustors
3. Remove backing plate from steering knuckle
4. Disconnect steering link
5. Remove stabilizer bar
6. Support lower control arm with jacks
7. Remove cotter pin and nut from upper and lower ball stud
8. Drive lower control ball stud out of steering knuckle
9. Remove steering knuckle from upper control arm ball stud
10. Remove bolts retaining ball joint in control arms or cut rivets loose
11. Remove and install new ball joints in control arms
12. Torque new bolts to proper specifications
13. Reinstall in reverse order

KNOWLEDGE/THEORY:

1. Function of steering knuckle ball joints
2. Function of independent front suspension components
    a. Shock absorbers
    b. Upper and lower control arms
    c. Stabilizers
    d. Coil springs
    e. Ball joints
    f. Steering knuckles
3. Method of ball joint attachment
    a. Rivets
    b. Bolts

VALUE/ATTITUDE CONCEPTS:

Awareness of safety practices while working beneath vehicle.

Awareness of safety factors involved with steering systems.

Awareness of importance of proper assembly and torquing.

TASK AREA: Chassis and Suspension

TASK #76: Aligns front end.

COMPETENCY: Check and adjust the angles of front end geometry to manufacturer's specifications.

CRITERION: Can properly make pre-alignment inspection.

Can properly install appropriate test equipment.

Can perform necessary checks to determine front end geometry and compare to manufacturer's specifications.

Can make necessary corrections to conform to manufacturer's specifications so vehicle will have minimum wear to parts, maximum tire mileage and safe operation.

SKILL/PROCESS:

1. Check spring height, tire pressure, wheel bearing adjustment and wheel run-out
2. Install appropriate test equipment to wheels
3. Check caster and camber and make necessary corrections
4. Check toe-in and make necessary adjustment

KNOWLEDGE/THEORY:

1. Function of front end geometry
    a. Tire wear
    b. Ease of steering
    c. Reduction of wear to front end parts
2. Principles of front end geometry
    a. Caster
    b. Camber
    c. King pin inclination
    d. Toe-in
    e. Turning radius (toe-out on turns)
3. Factors which influence alignment
    a. Tracking
        (1) Frame damage
        (2) Rear axle alignment
    b. Steering gear
        (1) Mounting
        (2) Adjustment
    c. King pins
    d. Wheel bearing
    e. Tie-rods and steering connection
    f. Spring shackles
    g. U-bolts
    h. Springs
        (1) Center bolts
        (2) Sag
        (3) Broken
    i. Tires
        (1) Inflation
        (2) Condition
    j. Wheel balance
    k. Brakes
    l. Shock absorbers
4. Techniques of adjustment for camber and caster
    a. Cams

    b. Shims
    c. Strut rods
    d. Axle correction (straight axle)
        (1) Twist
        (2) Bend
5. Techniques of adjustment of toe-in angle

VALUE/ATTITUDE CONCEPTS: Aware of the effects of alignment on safety, driver fatigue and tire wear.

TASK AREA: Chassis and Suspension

TASK #77: Removes and replaces king pin and bushings.

COMPETENCY: Remove and install king pins and bushings and adjust to manufacturer's specifications.

CRITERION: Can jack up and support front axle safely.

Can remove tires and steering linkage.

Can remove king pins and steering knuckles.

Can remove, install, and ream bushings.

Can install king pins and steering knuckles and adjust shim thickness according to manufacturer's specifications.

Can lubricate king pins.

Can install steering linkage and check toe-in.

SKILL/PROCESS:

1. Jack and secure vehicle off floor and remove wheel and hub assembly
2. Disconnect drag link from steering lever and steering tube from cross-steering levers
3. Remove brake mechanism assembly complete with anchor plate or spider assembly
4. Remove oil seal and retainer from upper knuckle boss. Remove expansion plug from lower boss
5. Remove draw pin
6. Drive knuckle pin out of knuckle and axle Remove knuckle and thrust bearing
7. Remove bushing from knuckle
8. Install new bushings into knuckle and line ream or hone to size if needed.
9. Lubricate knuckle pin and bushings and install knuckle and thrust bearing on axle
10. Install knuckle pin and hold knuckle with thrust bearing against axle center and adjust clearances to specification with spacing shims
11. Install draw pin
12. Install plugs or oil seals in upper & lower boss

KNOWLEDGE/THEORY:

1. Function of king pin
    a. Supports front wheel spindle to axle
    b. Provides for steering - turning of wheel
2. Components and function
    a. Bushing
    b. Pin
    c. Shim
    d. Draw key
    e. Seals
3. Types of front wheel assemblies
    a. Oil type
    b. Grease type
4. Types of backing plates and brake assemblies
    a. Cam type

   - b. Disc type
   - c. Wedge type
5. Disassembly techniques for tie-rod ends and drag links
6. Disassembly techniques for king pins and steering knuckle
7. Techniques for replacing bushing
   - a. Brass bushing
   - b. Nylon bushing
8. Reassembly of king pin
   - a. End play
   - b. Lubrication
   - c. Draw pin

VALUE/ATTITUDE CONCEPTS: Aware of the effects of alignment on safety, driver fatigue and tire wear.

TASK AREA: Chassis and Suspension

TASK #78: Removes and replaces front axle.

COMPETENCY: Remove and replace front axle assembly according to recommended procedures.

CRITERION: Can properly support vehicle and remove component parts.

Can properly remove and replace front axle assembly.

Can properly replace all component parts so as to assure safe operation of vehicle.

Can align front end or make necessary arrangements to assure vehicle is aligned before use.

SKILL/PROCESS:

1. Jack and secure vehicle off floor and remove wheel and hub assemblies
2. Disconnect drag link and steering tube
3. Remove brake mechanism spider or anchor plate
4. Remove steering knuckles
5. Remove u-bolts and lower axle to floor
6. Install new axle and tighten u-bolts to proper specifications
7. Install steering knuckles with proper clearances
8. Reassemble brake mechanism, steering linkage, wheels and hub assemblies
9. Lubricate assemblies
10. Check alignment for:
    a. Caster
    b. Camber
    c. Toe-in

KNOWLEDGE/THEORY:

1. Function of front axle assembly
    a. Attachment of steering knuckles, hubs, and tires
    b. Attachment of braking mechanism
    c. Attachment of springs and shocks
2. Front axle steering mechanism components and function
    a. Steering box
    b. Pitman arm
    c. Drag link
    d. Tie-rods and ends
    e. Steering knuckle assembly
3. Brake mechanism components and functions
    a. Brake spiders
    b. Brake shoes or pads
    c. Actuators
        (1) S-cam
        (2) Wedge
        (3) Disc
    d. Tires and fittings

4. Wheel and hubs components and function
    a. Rims
    b. Hubs
    c. Bearings
    d. Seals
    e. Lubrication
5. Front axle spring components and function
    a. Spring leafs
    b. Center bolts
    c. Shackle assembly
    d. Spring eye, bushing, and pins
    e. U-bolts
6. Fundamentals of steering geometry
    a. Caster
    b. Camber
    c. King pin inclination
    d. Turning radius
    e. Toe-in

VALUE/ATTITUDE CONCEPTS: Aware of the effects of alignment on safety, driver fatigue and tire wear.

TASK AREA: Chassis and Suspension

TASK #79: Removes and replaces springs.

COMPETENCY: Remove and replace spring assembly according to recommended procedures so vehicle's axle will be in alignment.

CRITERION: Can properly support frame and axle assembly.

Can properly remove spring assembly.

Can properly select and install spring assembly.

Can check alignment of axle or make necessary arrangements to assure vehicle is aligned before use.

SKILL/PROCESS: Front Axle:

1. Using jack or overhead crane, force weight of the chassis off the spring by lifting frame
2. Remove spring u-bolt nuts and u-bolts and disconnect shock absorber
3. Remove spring assemblies
   a. Remove fixed pin retaining bolts and nuts and remove fixed pin
   b. Remove retaining bolts and nuts and shackle pins from shackle assembly
   c. Raise chassis a little and remove spring from front axle (mark caster plates for position & direction for proper reassembly)
4. Replace spring assembly, install front fixed pin, bolts and nuts, torquing properly
5. Install shackle pins and retaining bolts and nuts if applicable. Torque properly
6. Lower chassis to axle, aligning center bolts to axle. Caster plates marked for proper position and direction. Install re-bolts and nuts, torquing in proper sequence and amount
7. Check alignment of front axle

Rear Axle:

1. Using jack or overhead crane, take weight off the chassis off the spring by lifting at frame
2. Remove fixed pin retaining bolts and nuts, remove fixed pin or remove eccentric bolt from front hanger
3. Remove rebound pins, front and rear if applicable
4. Remove u-bolt nuts and remove u-bolts
5. Remove spring assembly
6. Reinstall in reverse order
7. Torque all bolts and nuts in proper sequence and to proper values
8. Check alignment of rear axles

KNOWLEDGE/THEORY:

1. Safe jacking and supporting procedures
2. Types of springs
   a. Eye and slipper
   b. Eye and shackle
   c. Eye bolt with radius leaf (rear springs)
   d. Walking-beam types
3. Techniques of removing and handling heavy springs
4. Installation and torquing of fasteners
5. Lubrication techniques

VALUE/ATTITUDE CONCEPTS:

Awareness of safety in supporting vehicle.

Awareness of safety in lifting and removing heavy objects.

TASK AREA: Chassis and Suspension

TASK #80: Repairs or rebuilds spring assembly and shackles, hangers, and pads.

COMPETENCY: Visually check spring assembly, shackles and hangers for damage and wear to determine and make necessary repairs to restore axle alignment to specifications for the vehicle.

CRITERION: Can inspect for broken leaves, center bolts, shackle pins and for excessive wear on all parts.

Can replace and lubricate as appropriate shackle pins and other components.

Can replace center bolts without removing spring from the vehicle.

Can replace components bolted to the frame.

Can check for proper rear axle alignment and make necessary adjustments.

SKILL/PROCESS:

1. Visually inspect for worn and damaged spring assembly, shackles, hangers, or pads
2. Secure vehicle for removal of spring assembly
3. Remove broken, damaged, or worn parts
    a. Repair spring assembly
        (1) Support axle and frame
        (2) Remove spring assembly
        (3) Disassemble spring
        (4) Assemble spring leaves in proper sequence with new center bolt
        (5) Inspect spring eye bushing for wear and replace when worn, resizing to specifications
    b. Hangers and shackles and pins
        (1) Support frame and axle
        (2) Inspect for wear and damage
        (3) Replace worn or damaged parts
4. Lubricate pins
5. Check axle alignment and adjust to recommended specifications

KNOWLEDGE/THEORY:

1. Types of springs
    a. Eye and slipper
    b. Eye and shackle
    c. Eye bolt with radius leaf (rear springs)
    d. Walking-beam types
2. Safe jacking and supporting procedures
3. Principles of re-arching
4. Removal procedures for rivets
5. Procedures for installing and reaming bronze bushings
6. Installation and torquing of Grade 8 fasteners for spring hangers

7. Welding procedures for cast and forged parts
8. Lubrication techniques
9. Principles of front axle alignment
10. Principles of single rear axle and tandem axle alignment

VALUE/ATTITUDE CONCEPTS:	Awareness of safety in supporting vehicle. Awareness of safety in lifting and removing heavy objects.

TASK AREA: Chassis and Suspension

TASK #81: Removes and replaces torque arm bushings.

COMPETENCY: Visually check torque arm bushing for wear to determine need for replacement and replace correct bushings to restore alignment of axle and driveline to specifications of the vehicle.

CRITERION: Can visually check torque arm bushing to determine wear.

Can properly remove, select and install correct replacement bushings.

Can properly measure and correct driveline angularity to specification.

SKILL/PROCESS:

1. Visually inspect torque arm bushing
2. Remove torque arm and with proper tools press out worn bushing
3. Press new bushing into torque arm
4. Install torque arm with new bushing on truck
5. Check driveline angularity with protractor and set to specification

KNOWLEDGE/THEORY:

1. Function of torque arms
2. Techniques for replacing bushings
   a. Use of shop press
   b. Use of special installation tools
3. Installation techniques for torque arm on frame and axle
4. Principles of driveline angularity (refer to manufacturer's specifications)

VALUE/ATTITUDE CONCEPTS: Aware of the effect of misadjusted angles on noise and truck ride quality.

NOT INCLUDED IN THE
DIESEL VEHICLE MAINTENANCE
CURRICULUM

TASK AREA:	Body Work
TASK #82:	Installs fish plate on broken frame member

NOT INCLUDED IN THE
DIESEL VEHICLE MAINTENANCE
CURRICULUM

TASK AREA: Body Work

TASK #83: Removes and installs cross-member on frame.

NOT INCLUDED IN THE
DIESEL VEHICLE MAINTENANCE
CURRICULUM

TASK AREA: Body Work

TASK #84: Straightens or corrects damaged frame.

TASK AREA: Chassis and Suspension

TASK #85: Rebushs walking (equalizing) beam.

COMPETENCY: Visually check walking beam for wear to determine if bushing needs to be replaced and rebush with correct bushings to restore beam to manufacturer's tolerances.

CRITERION: Can visually determine excessive wear and need of replacement to bushing in walking beam.

Can properly support frame and axle to facilitate walking beam removal.

Can properly remove beam and replace bushings.

Can properly install beam and check axle alignment.

SKILL/PROCESS:

1. Visually inspect tandem axle assembly for walking beam bushing wear
2. Jack up vehicle and support frame
3. Use appropriate pulling tools and wrenches and remove beams from frame and axle
4. Use press and adapters and replace bushings in beams
5. Install beams on axles and frame
6. Check tandem alignment

KNOWLEDGE/THEORY:

1. Operation of walking beam suspension
2. Use of special pullers and removal tools
3. Use of end bushing and center bushing installation tools
4. Procedures for removing old bushings
5. Procedures for installing new bushings without damage or distortion
6. Methods for checking tandem axle alignment

VALUE/ATTITUDE CONCEPTS: Awareness of safety in supporting vehicle.

Awareness of safety in lifting and removing heavy objects.

TASK AREA: Chassis and Suspension

TASK #86: Aligns rear axle assembly.

COMPETENCY: Check and adjust alignment of rear axle assembly so assembly will be within manufacturer's specifications as to parallelism between both rear axle and front axle and perpendicular to the frame rails for proper tire wear and driveline regularity.

CRITERION: Can properly position vehicle to check axle alignment.

Can properly check alignment and make necessary adjustments or repairs so rear axle assembly will be within manufacturer's specification.

SKILL/PROCESS:

1. Clamp straight edge square with frame and measure axle alignment (single axle) or tandem alignment
2. Adjust torque arms or bolts to make measurements conform to manufacturer's specifications
3. Adjust both axles in tandem to be equally spaced between centers

KNOWLEDGE/THEORY:

Method A

1. Using alignment gauge (Bear No. 10B-15 or similar) square front wheels with the front system
2. Using tracking gauge (Bear No. 50.51 or similar) compare distances and pointer from side to side
3. Adjust torque arms or eccentric bolts until both readings (side to side) are equal and no open pointers
4. Adjust rear tandem to front tandem so as to have equal spacing between axle centers taking measurements on both sides of truck

Method B

1. Wheels must be running true or within manufacturer's specifications
2. On front tandem, measure between wheel rim and frame (both sides) if measurement out of specification, adjust torque arms or eccentric bolt until equal
3. Check rear axle, measure between wheel rim and frame (both sides), adjust until equal and within tolerance of the front axle
4. Check distance between axle center of tandems, both sides, should be within specifications

Method C

1. Determine a point on the frame rail (behind cab) that will permit clearance for a measuring device to contact the frame rail. This must be done on both sides of the truck. (This distance is optional but must be the same distance back from the front axle.)

2. To set the front axle perpendicular to the frame rail, attach a string or cord to some object behind the tires (the brake chamber for example)
3. Draw string around the tire at axle center point
4. Pull string tight and align until it just contacts tire rear and front
5. Keep string in this position, move to position frame rail as determined in Step 1, measure from this point out to string. Repeat on the other side of the vehicle
6. Adjust torque arms or eccentric bolt until both readings are equal
7. Measure between front tandem axle center to rear tandem axle center (both sides) adjust until equal

KNOWLEDGE/THEORY:

1. Function of rear axle assembly
2. Function of alignment
   a. Tire wear
   b. Parts wear
   c. Vehicle safety
3. Principles of rear axle alignment
   a. Tracking
   b. Parallelism
4. Principles of rear axle adjustment
   a. Equalizer beams
   b. Eccentric bushings
   c. Radius rods
      (1) Screw
      (2) Shim
   d. Eccentric blocks
5. Alignment measuring techniques
   a. Frame machine
   b. Use of square on frame
   c. Triangulation

VALUE/ATTITUDE CONCEPTS:

Awareness of effect of alignment on wear.

Awareness of safety in driving vehicle.

TASK AREA: Chassis and Suspension

TASK #87: Repair fifth wheel.

COMPETENCY: Visually check fifth wheel for wear and damage and make repairs or adjustments to restore to safe operating condition.

CRITERION: Can visually determine excessive wear or damage.

Can properly adjust or repair fifth wheel according to manufacturer's recommendations for safe operation.

SKILL/PROCESS:

1. Visually recognize wear, damage or looseness in fifth-wheel parts.
2. Remove and replace worn or damaged parts
3. Adjust jaws to restore proper clearance
4. Lubricate fifty wheel

KNOWLEDGE/THEORY:

1. Function of fifth wheel
2. Operation of jaw mechanism
3. Inspection procedure and/or measurement of wear to load bearing surface
4. Inspection procedure for wear in jaw mechanism
5. Techniques of removal of fifth wheel from chassis
6. Disassembly procedures
7. Welding techniques for cast and forged parts
8. Machining techniques for weld build-up repairs
9. Lubrication techniques
10. Adjusting procedures for jaw mechanism

VALUE/ATTITUDE CONCEPTS: Awareness of safety in the proper operation of the locking mechanism.

TASK AREA: Chassis and Suspension

TASK #88: Tests air brake system.

COMPETENCY: Perform tests on air brake system to verify it complies with the I.C.C.-D.O.T. standards.

CRITERION: Can properly prepare vehicle for testing.

Can properly perform I.C.C.-D.O.T. test and record results.

Can make recommendations as to compliance or needed repairs.

SKILL/PROCESS:

1. Secure vehicle to run engine and test braking system
2. Check brake balance with proper instruments
   a. Air pressure on each axle
   b. Slack adjuster level length
   c. Stroke length
   d. Diaphragm diameter
2. Check braking system for leaks and operation
   a. Compressor
   b. Control valve
   c. Governor
   d. Brake valve
   e. Relay emergency valve
   f. Quick release valve
   g. Tractor protection valve
3. Test braking system to comply with I.C.C.-D.O.T. standards
   a. Check stoplight switch operation
   b. Check low pressure indicators
   c. Pressure build-up time
   d. Governor setting limits
   e. Leakage test brakes applied
   f. Leakage test brakes released
   g. Automatic emergency brake operation
4. Compare test results for compliance or recommend needed repairs

KNOWLEDGE/THEORY:

1. Function of air brake system
2. Principles of air brake system
   a. Principles of compressed air
   b. Principles of braking
      (1) Wedge
      (2) Cam
3. Air brake system components, function, and operation
   a. Compressor
   b. Governor - air
   c. Storage tanks
   d. Check valves
   e. Application valves
      (1) Hand valve
      (2) Foot valve
         (a) Single
         (b) Dual

  - f. Quick release valves
  - g. Combination quick release - limiting
  - h. Relay valves
  - i. Inversion valves
  - j. Tractor protection valve
  - k. Double check valve
  - l. Stoplight switch
  - m. Brake pressure chambers
  - n. Shock adjuster
  - o. Air gauges
  - p. Audio low pressure indicator
  - q. Visual low pressure indicator
  - r. Air pressure relief valve
  - s. Spring brakes
  - t. Piping
- 4. Air brake system test - I.C.C. - D.O.T.
  - a. Function
    - (1) Operation
    - (2) Safety
  - b. Sequence
- 5. Determining if air brake system is "balanced"
  - a. Function
  - b. Checks for balance

VALUE/ATTITUDE CONCEPTS: Awareness of safety for driver and general public.

TASK AREA: Chassis and Suspension

TASK #89: Removes and replaces various air system components.

TASK #102: Services air brake system plumbing.

COMPETENCY: Remove and replace air system components using recommended procedures and check system for correct operation and/or compliance with manufacturer's specifications.

CRITERION: Can locate on the vehicle all components in the air system and test component for air leaks.

Can replace component without damage to tubing and other component.

Can correctly hook up all tubing.

Can operate the system and check for operation and to assure there are no leaks.

SKILL/PROCESS:

1. Secure vehicle to run engine and test air brake system
2. Operate all components in air brake system to determine malfunction
3. Locate defective component and identify air lines Remove without contaminating air system or damaging fittings or lines
4. Select and install replacement parts to assure no leakage and proper functioning

KNOWLEDGE/THEORY:

1. Function of air brake system
2. Principles of air brake system
    a. Principles of compressed air
    b. Principles of braking
        (1) Wedge
        (2) Cam
3. Air brake system component, function, and operation
    a. Compressor
    b. Air pressure governor
    c. Storage tanks
    d. Check valves
    e. Application valves
        (1) Hand valves
        (2) Foot valves
            (a) Single
            (b) Dual
    f. Quick release valves
    g. Combination quick release - limiting
    h. Relay valves
    i. Inversion valves
    j. Tractor protection valve
    k. Double check valve
    l. Stoplight switch
    m. Brake pressure chambers
    n. Slack adjusters
    o. Air gauges

    - p. Audio low pressure indicator
    - q. Visual low pressure indicator
    - r. Air pressure relief valve
    - s. Spring brakes
4. Principles of air system piping
    - a. Metal piping
        - (1) Flexible
        - (2) Ridged
    - b. Plastic piping
    - c. Fittings and connectors
    - d. Routing and clamping
5. Techniques of unit replacement
    - a. Cleaning
    - b. Identification of lines
    - c. Selection of fittings
    - d. Identification of parts
    - e. Special tools
6. Techniques of securing vehicle
    - a. Transmission
    - b. Brakes
    - c. Wheel chocks
    - d. Cab jacks and safety latches
7. Principles of engine shutdown system
    - a. Electrical
    - b. Mechanical

VALUE/ATTITUDE CONCEPTS: Awareness of safety in working with pressure systems.

Awareness of safety for driver and general public.

TASK AREA: Chassis and Suspension

TASK #90: Removes and replaces service brake chamber diaphragm.

COMPETENCY: Remove and replace service brake chamber diaphragm following correct safety procedures so that service and parking brakes will operate according to manufacturer's recommendations.

CRITERION: Can properly secure spring brake assembly for removal if so equipped or remove service brake chamber cover.

Can select proper replacement parts and install to manufacturer's recommendations.

Can properly test completed installation to assure functioning of service and parking brakes.

SKILL/PROCESS:

1. Mechanically or with air compress the spring brake's actuating spring if so equipped
2. Pull push-rod outward and secure
3. Loosen retaining clamp and remove service chamber cover or spring brake assembly
4. Remove service brake chamber diaphragm; clean seal edges of brake chamber and cover; install new diaphragm
5. Install service brake chamber cover or spring brake assembly, torquing retaining clamp to specification
6. Remove push-rod securing device and return spring brake assembly to operational condition
7. Test diaphragm for air leakage and proper brake application

KNOWLEDGE/THEORY:

1. Function of air brake chambers
2. Principles of air brake chamber
    a. Compressed air principle
    b. Push rod force (psi x diaphragm area)
3. Components and function of air brake chambers
    a. Chamber types
    b. Diaphragm types
    c. Push rod
    d. Return spring
    e. Construction
        (1) Mounting
        (2) Air inlet part
4. Function of spring brakes
5. Construction of spring brakes
6. Methods of securing spring brakes
    a. Mechanical
    b. Shop air pressure

VALUE/ATTITUDE CONCEPTS: Awareness of proper procedures in working with chambers.

TASK AREA: Chassis and Suspension

TASK #91: Removes and replaces brake shoes.

COMPETENCY: Remove and replace brake shoes using correct procedures and adjust to manufacturer's specifications.

CRITERION: Secures vehicle and removes axle (on rear), wheel, and hub assemblies.

Can safely remove shoe return springs.

Can remove, select correct replacement shoes or reline shoes, and replace.

Can inspect, return springs, rollers and anchor pins for wear and determine needed replacement parts.

Can reinstall axle (on rear) wheel and hub assemblies and adjust to manufacturer's recommendations.

SKILL/PROCESS:

1. Secure vehicle safely on stands
2. Remove axle and rear wheel
3. Remove wheel and hub assemblies
4. Remove shoe return spring safely
5. Select correct shoe or reline old shoe
6. Inspect return springs, rollers, anchor pins for wear
7. Install brake shoe and component parts
8. Install wheel and hub assemblies
9. Install axle
10. Adjust brakes

KNOWLEDGE/THEORY:

1. Function of brake shoes
2. Principles of braking
    a. Co-efficient of friction
    b. Heat dissipation
    c. Pressure
3. Brake linings
    a. Materials
    b. Construction
4. Types of brake shoe foundations
    a. Fabricated
    b. Cast
5. Types of brake lining attachments
    a. Bonding
    b. Rivets
        (1) Types
        (2) Material
        (3) Selection
    c. Bolts
        (1) Types
        (2) Materials
6. Technique of relining
    a. Removal of lining
    b. Cleaning
        (1) Mechanical
        (2) Chemical
        (3) Glass/sand cleaning

c. Inspection
    (1) Pin to anchor dimension
    (2) Warpage - distortion
d. Replacement of lining
    (1) Riveting sequence
    (2) Bolting sequence and torque

VALUE/ATTITUDE CONCEPTS: Awareness of safety practices involved in brake shoe replacement.

TASK AREA: Chassis and Suspension

TASK #92: Relines brake shoes.

COMPETENCY: Remove, clean and install new linings according to manufacturer's specifications.

CRITERION: Can properly remove old linings from brake shoes.

Can properly clean, inspect and make recommendations for reuse of shoe.

Can properly select lining, rivets or bolts and correctly install linings to shoes.

SKILL/PROCESS:

1. Remove old lining from brake shoe
2. Clean and inspect for reuse
3. Select proper lining, rivets, or bolts
4. Bolt or rivet lining to shoe according to recommended procedures

KNOWLEDGE/THEORY:

1. Function of brake shoes and linings
2. Brake linings
    - a. Material
    - b. Construction
3. Types of brake shoe foundations
    - a. Fabricated
    - b. Cast
4. Types of brake lining attachment
    - a. Bonding
    - b. Riveting
        - (1) Types
        - (2) Material
        - (3) Selection
    - c. Bolts
        - (1) Types
        - (2) Material
        - (3) Selection
5. Techniques of relining
    - a. Removal of lining
    - b. Cleaning
        - (1) Mechanical
        - (2) Chemical
        - (3) Glass/sand cleaning
    - c. Inspection
        - (1) Pin to anchor dimension
        - (2) Warpage - distortion
    - d. Replacement of lining
        - (1) Riveting sequence
        - (2) Bolting sequence and torque

VALUE/ATTITUDE CONCEPTS: Awareness of safety practices in using asbestos.

TASK AREA: Chassis and Suspension

TASK #93: Overhauls air brake actuator assemblies.

COMPETENCY: Rebuild air brake actuator assemblies to apply and release brakes according to manufacturer's specifications.

CRITERION: Can properly remove and disassemble actuator assemblies using safety practices.

Can clean, inspect and repair in accordance with manufacturer's recommendations.

Can properly install actuator assemblies according to manufacturer's specifications.

SKILL/PROCESS:

1. Remove wheels and hubs
2. Disassemble actuators and clean parts
3. Repair parts as appropriate
    a. S-cam actuators
        (1) Replace cam bushings
        (2) Repair and machine S-cam shafts
        (3) Repair push rod and clevis
        (4) Replace diaphragms and springs
    b. Wedge actuators
        (1) Replace wedges and rollers as appropriate
        (2) Replace self adjusting mechanisms as appropriate
        (3) Replace diaphragms
4. Reassemble actuators
5. Adjust components to manufacturer's specifications

KNOWLEDGE/THEORY:

1. Function of brake actuators
2. Principles of brake actuators
    a. Cams
    b. Wedges
3. Actuator components, function, cleaning and testing
    a. Cam type
        (1) Bushings
        (2) Camshaft
        (3) Slack adjusters
        (4) Push rod and clevis
        (5) Brake air chambers
    b. Wedge type
        (1) Wedge assemble
        (2) Plunge housing assemble
        (3) Brake air chamber assemble
4. Rear axles
    a. Function
    b. Construction
    c. Removal and replacement

5. Hub assembly
    a. Function
    b. Construction
    c. Bearings and adjustments
    d. Seals

VALUE/ATTITUDE CONCEPTS: Awareness of proper procedure and safety.

TASK AREA: Chassis and Suspension

TASK #94: Removes and replaces spring brake chambers.

COMPETENCY: Following correct safety procedures, remove and replace spring brake chambers so that spring brake chamber functions according to manufacturer's recommendations.

CRITERION: Can cage parking brake spring so that chamber can be safely removed.

Can replace chamber without damage to tubing or fittings.

Can adjust slack adjuster to manufacturer's specifications.

SKILL/PROCESS:

1. Cage chamber for removal
2. Remove chamber from vehicle
3. Replace new chamber to vehicle
4. Replace fittings and tubing without damage
5. Adjust slack adjuster to specification

KNOWLEDGE/THEORY:

1. Function of spring brakes
    a. Parking
    b. Emergency
2. Principle of spring brake operation
    a. Air released
    b. Spring applied
3. Types of spring brakes
    a. Piston
    b. Diaphragm
4. Types of caging
    a. Mechanical
    b. Shop air
5. Fittings and tubing
    a. Types
    b. Assembly techniques
6. Slack adjusters
    a. Function
    b. Adjustment techniques

VALUE/ATTITUDE CONCEPTS: Awareness of proper procedure and safety.

TASK AREA: Chassis and Suspension

TASK #95: Repairs or rebuilds spring brakes.

COMPETENCY: Following correct safety procedures, disassemble and repair spring brakes according to manufacturer's specifications.

CRITERION: Can safely and properly disassemble spring brake cage.

Can properly clean, inspect and make recommendations for reuse.

Can select proper reconditioning technique and replacement parts to repair in accordance to manufacturer's specifications.

Can properly assemble unit to function in accordance to manufacturer's specifications.

SKILL/PROCESS:

1. Disassemble spring brake cage using press or holding tools
2. Clean and inspect for reuse
3. Recondition and replace parts to manufacture's specifications
4. Test unit for air leaks and for proper functions according to manufacture's specifications

KNOWLEDGE/THEORY:

1. Function of spring brakes
   a. Parking
   b. Emergency stopping
2. Principle of spring brake operation
   a. Air released
   b. Spring applied
3. Types of spring brakes
   a. Piston
   b. Diaphragm
4. Piston type spring brake components, function, and repair
   a. Piston housing
      (1) Seals
      (2) Surfaces
   b. Piston and seal
   c. Power spring and caging
   d. Venting valves
5. Diaphragm type spring brake
   a. Housing
   b. Diaphragm
   c. Power - spring and caging

VALUE/ATTITUDE CONCEPTS: Awareness of safety procedures.

TASK AREA: Chassis and Suspension

TASK #96: Removes, replaces, and adjusts air governor.

COMPETENCY: Remove, replace, and adjust air governor to manufacturer's operating specifications for cut in pressure and cut out pressure.

CRITERION: Can safely secure vehicle and run engine to test air governor operation.

Can properly remove and install new air governor and adjust to manufacturer's specifications.

SKILL/PROCESS:

1. Secure vehicle
2. Run engine to test air governor operation
3. Remove air governor
4. Install new governor
5. Run engine to test for leaks and adjust new air governor

KNOWLEDGE/THEORY:

1. Function of air governors
2. Principle of air governor operation
   a. Compressor cut in pressure
   b. Compressor cut out pressure
3. Air governor mounting
   a. Compressor mount
   b. Remote mount
4. Governor adjustment technique
5. Techniques of securing vehicle
   a. Transmission
   b. Brakes
   c. Cab jacks and safety lock
   d. Wheel chocks
6. Principles of engine shut down systems
   a. Electrical
   b. Mechanical

VALUE/ATTITUDE CONCEPTS: Awareness of cut-in/cutout pressure for safety of brake operation.

TASK AREA: Chassis and Suspension

TASK #97: Adjusts brakes.

COMPETENCY: Adjust brakes for maximum braking effort to assure vehicle brakes without pulling to either side and wheels turn freely when brakes are released.

CRITERION: Can safely and properly secure vehicle.

Can identify type of brake actuating mechanism and select appropriate adjustment technique.

Can adjust shoe to drum clearance to manufacturer's specification or recommendations according to type braking system.

Can determine if vehicle's braking system is properly "balanced" and make correction when necessary.

SKILL/PROCESS:

1. Secure vehicle safely for adjusting brakes
2. Select appropriate tools for activating mechanism
3. Adjust brake shoe to drum clearance according to manufacturer's specifications
4. Check vehicle for free turning of wheels and pulling on brake application

KNOWLEDGE/THEORY:

1. Function of brake actuating mechanism
2. Types of hydraulic brake actuating mechanism and adjustment:
    a. Non-servo
    b. Wagner twin action
    c. Wagner Type "F"
    d. Wagner Type "FA"
    e. Wagner Type "FR-3"
    f. Wagner Type "FR3A", "FR5A"
    g. Bendix Duo Servo
    h. Bendix Two-Piston
    i. Bendix Single anchor
    k. Kelsey-Hayes
3. Types air brake actuating mechanism and adjustment
    a. Wedge type
    b. "S" cam type
4. Principles of "balanced system" on air brakes
    a. Diaphragm size
    b. Slack adjuster length
    c. Air pressure to diaphragm
    d. Lining co-efficient
    e. Stroke length and angularity

VALUE/ATTITUDE CONCEPTS: Awareness of accuracy in adjustment for safety in stopping vehicle.

TASK AREA: Chassis and Suspension

TASK #98: Rebuilds hydraulic brake master cylinder.

COMPETENCY: Rebuild hydraulic brake master cylinder with parts that meet manufacturer's specifications so that cylinder performs with no leaks, binding, or loss of operating pressure.

CRITERION: Can remove brake master cylinder from vehicle without damage to brake lines or linkages.

Can disassemble brake master cylinder, hone cylinder bore and inspect for serviceability.

Can reassemble brake master cylinder, fill with fluid and bleed. (Making sure residual check valve is installed.)

Can install brake master cylinder on vehicle and adjust pedal linkage.

SKILL/PROCESS:

1. Remove master cylinder without damage to links or linkages
2. Clean master cylinder and disassemble
3. Hone cylinder and check bore for serviceability
4. Reassemble master cylinder, fill with fluid and bleed before installation
5. Install master cylinder and check pedal linkage adjustment

KNOWLEDGE/THEORY:

1. Function of hydraulic brake master cylinder
2. Principles of hydraulics
    a. Liquids have no shape of their own
    b. Liquids will not compress
    c. Liquids transmit applied pressure in all directions
    d. Liquids provide great increases in work force
3. Master cylinder components, function, cleaning, and rebuilding
    a. Body
    b. Piston
    c. Residual pressure valve
    d. Return springs
    e. Cups and seals
4. Mechanical checks
    a. Cup condition
    b. Cylinder bore surface
    c. Cylinder bore diameter
    d. Piston condition
    e. Output port thread condition
5. Hydraulic checks
    a. Residual pressure
    b. Internal leakage of primary cup
    c. External leakage
6. Techniques of bench bleeding of master cylinder
7. Techniques of push rod adjustment

VALUE/ATTITUDE CONCEPTS: Awareness of cleanliness and safety.

TASK AREA: Chassis and Suspension

TASK #99: Rebuilds hydraulic slave (wheel) cylinder.

COMPETENCY: Rebuild hydraulic slave (wheel) cylinder with parts that meet manufacturer's specifications so that cylinder performs with no leakage, binding, or loss of pressure.

CRITERION: Can secure vehicle and remove appropriate wheel components to gain access to hydraulic slave (wheel) cylinder according to manufacturer's recommendations and/or specifications for rebuilding cylinder.

Can properly disassemble and clean slave cylinder.

Can select proper tools or equipment to recondition, inspect and make recommendation for reuse.

Can select proper parts and install to manufacturer's recommendations.

Can install slave (wheel) cylinder according to manufacturer's specifications or recommendations, fill system with fluid, and bleed system.

SKILL/PROCESS:

1. Secure vehicle and remove wheel and brake shoes
2. Remove wheel cylinder from backing plate
3. Disassemble and clean cylinder
4. Hone cylinder bore and inspect for reuse
5. Select parts and reassemble cylinder
6. Install wheel cylinder shoes and springs
7. Install wheel, fill master cylinder with fluid and bleed wheel cylinder

KNOWLEDGE/THEORY:

1. Function of hydraulic slave cylinder
2. Principles of hydraulics
   a. Liquids have no shape of their own
   b. Liquids will not compress
   c. Liquids transmit applied pressure in all directions
   d. Liquids provide great increases in work force
3. Hydraulic slave cylinder components, function, cleaning, and repairs
   a. Cylinder body
   b. Cup
   c. Spring
   d. Piston
   e. Boot
   f. Bleed screw
4. Mechanical checks
   a. Cup condition
   b. Cylinder bore surface
   c. Cylinder bore diameter
   d. Piston condition
   e. Bleed screw threads

5. Hydraulic checks
    External leakage
6. Techniques of bleeding
    a. Manual
    b. Power

VALUE/ATTITUDE CONCEPTS: Awareness of cleanliness and safety.

TASK AREA: Chassis and Suspension

TASK #100: Removes and replaces power brake unit.

COMPETENCY: Remove and replace power brake unit and adjust to function according to manufacturer's specifications.

CRITERION: Can remove and replace power brake unit without damage to lines, fittings or linkages.

Can make linkage adjustments if required.

Can determine the need to bleed and if needed, bleed power brake unit and entire brake system.

SKILL/PROCESS:

1. Remove power brake unit without damage to lines, fitting or linkages
2. Install power brake unit and adjust linkage if needed
3. Bleed power brake units and check for proper operation

KNOWLEDGE/THEORY:

1. Principles of brake unit operation
    a. Mechanical components
    b. Vacuum components
    c. Air components (air over hydraulic)
    d. Hydraulic components
2. Principles of hydraulic brake systems
    a. Master cylinder
    b. Slave cylinders
    c. Steel and flexible lines
3. Removal and replacement techniques
    a. Keep contamination out of lines and master cylinder
    b. Bleeding with brake pedal
    c. Bleeding with pressure tank

VALUE/ATTITUDE CONCEPTS: Awareness of cleanliness and safety.

TASK AREA: Chassis and Suspension

TASK #101: Balances tires.

COMPETENCY: Balance tires to run free of vibration in accordance with recommended specifications of equipment being used to balance the tire.

CRITERION: Can inspect tires to determine if tire is in condition to be balanced.

Can position and secure vehicle for balancing of tire.

Can determine most appropriate method of balancing tire.

Can balance tire by appropriate method, adding, locating, and securing weights appropriately to assure balance of tire by visual and feel observation methods.

SKILL/PROCESS:

Bubble Balancers:

1. Remove tires and rim assembly
2. Mount on balancer
3. Position weights
4. Replace tire and rim assembly

Dynamic Balancing on Vehicles:

1. Raise vehicle off floor - support with stands, axle, and wheels hanging free
2. Turn wheel to outside and secure
3. Position wheel balancer (see manufacturer's specifications)
4. Balance tire statically and dynamically
5. Lower vehicle to ground

Dynamic Balancing Off-Vehicle:

1. Remove tires and rim assembly
2. Mount on balancing machine
3. Follow manufacturer's balancing recommendations for balancing
4. Balance statically
5. Balance dynamically
6. Replace tire and rim assembly

KNOWLEDGE/THEORY:

1. Purpose of wheel balancing
   a. Line life
   b. Bearing and front end wear
   c. Driver comfort and safety
2. Theory of balancing
   a. Static
   b. Dynamic
3. Types of wheel balancers
   a. Bubble static
   b. Dynamic
      (1) On vehicle
      (2) Off vehicle

4. Types of wheel weights
    a. Stick on weight
    b. Clamp on weight
5. Types of wheel rims

VALUE/ATTITUDE CONCEPTS: Awareness of tire balance effect on vehicle handling.

TASK AREA: Chassis and Suspension

TASK #102: Services air brake system plumbing.

Listed with Task #89

TASK AREA: Chassis and Suspension

TASK #103: Repairs, replaces, or adjusts air pressure relief valve.

COMPETENCY: Make test to determine relief valve malfunctions and make necessary repairs, replacements, or adjustments for valve to operate within prescribed limits.

CRITERION: Can safely secure vehicle to run engine.

Can determine if relief valve malfunctions and whether it can be adjusted, serviced or needs replacement.

Can make appropriate repairs and retest to determine if unit functions within prescribed limits.

SKILL/PROCESS:

1. Secure vehicle to run engine
2. Test relief valve for proper operation
3. Adjust or replace valve as needed
4. Run engine and test relief valve to determine if it functions within prescribed limits

KNOWLEDGE/THEORY:

1. Function of air pressure relief valve
2. Techniques of testing pressure relief valve
   a. Air governor block
   b. Shop pressure
3. Air pressure relief valve component function, cleaning, inspection
   a. Body
   b. Ball valve
   c. Spring
   d. Adjustment screw
4. Techniques of adjustment

VALUE/ATTITUDE CONCEPTS: See general list on Page 11.

TASK AREA: Hydraulics

TASK #104: Cleans and blows out fins on oil cooler.

COMPETENCY: Clean and blow out fins on oil cooler using appropriate cleaning technique to assure unobstructed air flow and heat exchange.

CRITERION: Can steam clean, pressure wash or solvent clean oil cooler as appropriate.

Inspect oil cooler and straighten fins if appropriate for unobstructed air flow.

SKILL/PROCESS:

1. Select steam cleaner, pressure washer, or solvent as appropriate
2. Clean fins and inspect for broken weld, braze and solder joints
3. Straighten fins

KNOWLEDGE/THEORY:

1. Function
    a. Transfer heat from oil
    b. Maintain hydraulic system oil temperature
2. Types
    a. Tube or shell type
    b. Fin type
3. Construction
    a. Tube and shell type
        (1) In housing
        (2) Surrounded by water
    b. Fin type
        (1) Fins
        (2) Tubes
        (3) Tanks
4. Cleaning fin type
    a. Removal of debris
    b. Protection of fins
5. Cleaning tube type
    a. Chemicals
    b. Rodding tubes

VALUE/ATTITUDE CONCEPTS: Importance of correct temperature to adequate service life of oil and hydraulic system.

TASK AREA: Hydraulics

TASK #105: Removes from housing and pressure tests oil coolers.

COMPETENCY: Remove and pressure test oil coolers according to pressure test specifications to determine if oil cooler leaks.

CRITERION: Can properly disassemble oil cooler.

Can properly clean and visually inspect for damage or leaks.

Can pressure test oil cooler element to determine if element has any leaks according to manufacturer's specifications.

SKILL/PROCESS:

1. Disassemble oil cooler without damage to element
2. Clean and visually inspect for leaks
3. Test oil cooler element with correct pressure according to manufacturer's specifications

KNOWLEDGE/THEORY:

1. Function
    a. Transfer heat from oil
    b. Maintain hydraulic system oil temperature
2. Types
    a. Tube or shell type
    b. Fin type
3. Construction
    a. Tube and shell type
        (1) In housing
        (2) Surrounded by water
    b. Fin type
        (1) Fins
        (2) Tubes
        (3) Tanks
4. Pressure test
    a. Limited air pressure
    b. In water
5. Repair
    a. Solder
    b. Braze

VALUE/ATTITUDE CONCEPTS: Importance of correct temperature to adequate service life of oil and hydraulic system.

TASK AREA: Hydraulics

TASK #106: Replaces gaskets and seals and reassembles oil coolers in housing.

COMPETENCY: Replace gaskets, seals, and reassemble oil cooler in housing and check to assure there are no leaks.

CRITERION: Can select proper parts for needed repairs.

Can properly install gaskets and seals and reassemble oil cooler to assure no leakage.

Can properly test assembled unit to assure proper functioning.

SKILL/PROCESS:

1. Can clean housing and select parts for repairs
2. Can reassemble oil cooler with new seals and gaskets
3. Can test oil cooler to assure proper functioning

KNOWLEDGE/THEORY:

1. Function
    a. Transfer heat from oil
    b. Maintain hydraulic system oil temperature
2. Types
    a. Tube or shell type
    b. Fin type
3. Construction
    a. Tube and shell type
        (1) In housing
        (2) Surrounded by water
    b. Fin type
        (1) Fins
        (2) Tubes
        (3) Tanks
4. Types of gaskets and seals
    a. O-ring seals
    b. Gasket
5. Testing
    a. Replace in housing for test
    b. Air pressure test
    c. Oil in water or air bubbles

VALUE/ATTITUDE CONCEPTS: Special care not to damage o-rings.

TASK AREA: Hydraulics

TASK #107: Repairs and adjusts hydraulic accumulators.

COMPETENCY: Test hydraulic accumulators using test instruments to determine if operation is within manufacturer's specifications and make repairs and adjustments necessary to assure proper operation of unit.

CRITERION: Can use pressure gauges and flow meter to determine if accumulator is functioning properly.

Can remove accumulator from system with minimum loss of oil.

Can safely disassemble spring loaded and gas charged accumulators.

Can replace parts and reassemble unit.

Can install accumulator in hydraulic system, add correct oil, run system, and check for leaks.

SKILL/PROCESS:

1. Hook up pressure gauges and flow meter and operate system to determine if accumulator circuit is functioning properly
2. Release all hydraulic pressure in accumulator circuit
3. Remove accumulator from machine
4. Cap lines for minimum oil loss
5. Release gas or spring pressure following manufacturer's specifications
6. Select recommended parts and assemble to manufacturer's specifications
7. Install accumulator on machine, bleed systems, and check proper action
8. Run system and check for leaks

KNOWLEDGE/THEORY:

1. Function
    a. Stores energy
    b. Absorb shock
    c. Gradual pressure buildup
    d. Maintain construct pressure
2. Types
    a. Pneumatic
    b. Weight loaded
    c. Spring loaded
3. Construction
    a. Adjustable
    b. Recondition all types
    c. Throwaway type

VALUE/ATTITUDE CONCEPTS: Observes safety practices in working with strong springs.

Aware of criticality of using proper charging gas to precharge accumulators.

TASK AREA: Hydraulics

TASK #108: Services hydraulic control valve bodies.

COMPETENCY: Service hydraulic control valve by disassembling valve to inspect, clean, and replace parts to restore valve for free movement and to eliminate leakage.

CRITERION: Can remove valve from hydraulic system with minimum loss of oil and no entry of dirt into system.

Can disassemble valve without damage to spool or bore.

Can inspect spool and bore and make decision on reuse or replacement.

Can replace o-rings and seals and reassemble valve without damage to seals.

Can install valve in system, replace oil, and run system to check for leaks and proper operation.

SKILL/PROCESS:

1. Disconnect electrical power
2. Move valve in all directions to bleed pressure from system
3. Support all hydraulic working units
4. Clean valve area
5. Remove valve body and plug all open lines and ports
6. During disassembly, mark parts for reassembly Remove spools from bores carefully
7. Clean all parts in mineral oil solvent and dry with air
8. Inspect valve body bores and spool surfaces
9. Inspect springs for deformity and proper tension
10. Lubricate and assemble seals, o-rings, valves, and springs into valve body.
11. Remove plugs from lines and ports and install valve body to proper specifications and torque
12. Connect lines
13. Service system to proper oil level
14. Remove supports and connect power
15. Operate system and check for proper operation and leaks

KNOWLEDGE/THEORY:

1. Function and types
    a. Control pressure
        (1) Limit
        (2) Reduce
        (3) Set pressure
        (4) Unload
    b. Control direction
        (1) Check
        (2) Rotary
        (3) Spool
    c. Control volume
        (1) Flow control
        (2) Flow divider
2. Construction

    - a. Precision
    - b. Parts
        - (1) Body and bores
        - (2) Valve
        - (3) Springs
        - (4) Ball
        - (5) Seats
- 3. Servicing
    - a. Cleaning agents
    - b. Protection of components
    - c. Matched components

VALUE/ATTITUDE CONCEPTS:

Awareness of care required to prevent damage to precision parts.

Awareness of prevention of contaminants from precision parts.

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TASK AREA: Hydraulics

TASK #109: Rebuilds hydraulic clutch master cylinder.

COMPETENCY: Rebuild hydraulic clutch master cylinder with parts that meet manufacturer's specifications so that cylinder performs with no leakage, binding, or loss of pressure.

CRITERION: Can remove clutch master cylinder from vehicle without damage to brake lines or linkages.

Can disassemble clutch master cylinder, hone cylinder bore and inspect for serviceability.

Can reassemble clutch master cylinder, fill with fluid and bleed. (Making sure residual valve is not used.)

Can install clutch master cylinder on vehicle and adjust pedal linkage.

SKILL/PROCESS:

1. Select tools
2. Clean master cylinder to prevent entry of dirt in system
3. Disconnect lines and linkage
4. Remove master cylinder
5. Disassemble in the proper sequence
6. Inspect cylinder and hone bore
7. Select proper overhaul kit (leave out residual valve)
8. Reassemble in the reverse order of disassembly
9. Fill with fluid and bleed
10. Reinstall on vehicle and connect lines and linkage
11. Check for leaks and adjust pedal and linkage

KNOWLEDGE/THEORY:

1. Function of hydraulic brake master cylinder
2. Principles of hydraulics
    a. Liquids have no shape of their own
    b. Liquids will not compress
    c. Liquids transmit applied pressure in all directions
    d. Liquids provide great increases in work force
3. Master cylinder components, function, cleaning and rebuilding
    a. Body
    b. Piston
    c. Return springs
    d. Cups and seals
4. Mechanical checks
    a. Cup condition
    b. Cylinder bore surface
    c. Cylinder bore diameter
    d. Piston condition
    e. Output port thread condition

5. Hydraulic checks
    a. Internal leakage of primary cup
    b. External leakage
6. Techniques of bench bleeding of master cylinder
7. Techniques of push rod adjustment

VALUE/ATTITUDE CONCEPTS:

Awareness of care required to prevent damage to precision parts.

Awareness of prevention of contaminants from precision parts.

TASK AREA: Power Trains

TASK #110: Removes and reinstalls transmission.

COMPETENCY: Remove and replace transmissions using recommended safety practices and procedures checking to assure shift and clutch mechanisms operate according to manufacturer's recommendations.

CRITERION: Can properly secure vehicle for transmission removal.

Can determine need for engine support and select proper equipment.

Can properly disconnect linkages, hoses, and drive line.

Can select proper tools and equipment to facilitate removal and installation of transmission.

Can properly reassemble linkages, hoses, and drive line to operate according to manufacturer's recommendations.

SKILL/PROCESS:

1. Use appropriate hoist or jack to support engine while transmission is removed
2. Disconnect clutch and shift linkage and hoses
3. Disconnect driveline
4. Remove transmission while taking care not to damage clutch or transmission input shaft
5. Install transmission taking care to line up clutch discs and release bearing mechanism
6. Reconnect all hoses and linkages

KNOWLEDGE/THEORY:

1. Type of engine and transmission mounting
2. Removal and installation procedures
    a. Methods of engine supporting
    b. Techniques of transmission removal
3. Driveline phasing
4. Clutch linkage adjusting procedures
5. Transmission shift linkage adjusting procedures

VALUE/ATTITUDE CONCEPTS: Awareness of proper placement of jack to transmission, proper securement of transmission to jack.

Cover all openings in transmission.

TASK AREA: Power Trains

TASK #111: Removes and replaces single plate clutch (transmission removed).

COMPETENCY: Remove and replace pressure plate and disc using recommended procedure to assure smooth clutch engagement and disengagement.

CRITERION: Can remove pressure plate and disc from flywheel.

Can inspect flywheel for cracks, warpage, and heat checks.

Can install pressure plate and disc while using line-up shaft, without warping clutch cover, to assure smooth engagement and disengagement.

SKILL/PROCESS:

1. Install line-up shaft to keep clutch parts in correct order
2. Unbolt clutch cover in sequence to prevent warping
3. Inspect flywheel for warpage, cracks, and excessive heat checking
4. Inspect pressure plate for warpage, cracks, and excessive heat conditions
5. Install pressure plate assembly and driven disc on flywheel using appropriate line-up shaft
6. Torque clutch cover bolts in sequence to prevent warpage

KNOWLEDGE/THEORY:

1. Clutch operation
2. Use of straight edge and measuring tools
3. Use of service specifications for obtaining dimensions
4. Effects of heat checks on clutch operation
5. Torquing techniques
6. Use of line-up shaft

VALUE/ATTITUDE CONCEPTS: See general list on Page 11.

TASK AREA: Power Trains

TASK #112: Removes and replaces two-plate clutch (transmission removed).

COMPETENCY: Remove and replace pressure plate, intermediate plate, and disc using recommended procedures to assure smooth engagement and disengagement.

CRITERION: Can remove pressure plate assembly, intermediate plate and discs.

Can inspect flywheel for cracks, warpage, heat checks, runout, and condition of intermediate plate drive lugs.

Can install pressure plate assembly, intermediate plate and discs, while using line-up shaft, without warping clutch cover.

SKILL/PROCESS:

1. Install line-up shaft to keep clutch parts in correct order during removal
2. Unbolt clutch cover in sequence to prevent warping
3. Inspect flywheel for cracks, warpage, and excessive heat checking
4. Inspect condition of intermediate plate drive lugs
5. Install driven discs, intermediate plate and pressure plate assembly using line-up shaft to maintain position
6. Torque clutch cover bolts in sequence to prevent warpage

KNOWLEDGE/THEORY:

1. Clutch operation
2. Use of straight edge and measuring tools
3. Use of service specifications for obtaining dimensions
4. Effects of heat checks on clutch operation
5. Function of intermediate plate drive lugs
6. Proper positioning of long and short hubs on drive discs
7. Torquing techniques
8. Use of line-up shaft

VALUE/ATTITUDE CONCEPTS: See general list on Page 11.

TASK AREA: Power Trains

TASK #113: Replaces flywheel drive lugs for two-plate clutch.

COMPETENCY: Replace intermediate plate drive lugs to manufacturer's specifications.

CRITERION: Can remove drive lugs without damage to flywheel.

Can select proper drive lugs and install to assure free movement of intermediate drive plate.

SKILL/PROCESS:

1. Remove set screws or nuts and remove drive lugs
2. Select proper drive lugs to fit make of engine
3. Install drive lugs with flat sides square with flywheel face
4. Install intermediate plate and check lug clearances with feeler gauge
5. Install set screws or nuts

KNOWLEDGE/THEORY:

1. Function of clutch
2. Function of drive lugs and intermediate plate
3. Removal techniques
4. Installation techniques
   a. Square lugs with flywheel surface
   b. Check intermediate plate and drive lug clearance with feeler gauge
   c. Secure lugs tightly with nut or set screws

VALUE/ATTITUDE CONCEPTS: Awareness of accurate installation of drive lugs for proper alignment.

TASK AREA: Power Trains

TASK #114: Aligns engine flywheel housing.

COMPETENCY: Using gauges and instruments, align flywheel housing with crankshaft within manufacturer's tolerances for radial and lateral run-out.

CRITERION: Can properly clean and prepare surfaces for use of test instruments in aligning flywheel housing.

Can properly install gauges and instruments to determine flywheel housing position of alignment and direction of moving to correct alignment.

Can properly align flywheel housing to be within manufacturer's tolerances.

SKILL/PROCESS:

1. Remove dirt and rust from transmission mounting surface
2. Install dial indicator on crankshaft and check radial and lateral run-out
3. Remove dowel pins, loosen bolts and move flywheel housing to bring run-out to manufacturer's specifications
4. Torque bolts, ream dowel pin holes and install oversize dowels

KNOWLEDGE/THEORY:

1. Operation of transmission and clutch pilot bearing
2. Cleaning techniques for mounting surfaces
3. Alignment
   a. Radial run-out
   b. Lateral run-out
   c. Checking with dial indicator
4. Torquing techniques and specification
5. Dowel pins
   a. Function
   b. Installation

VALUE/ATTITUDE CONCEPTS: Awareness of importance of maintaining proper alignment for clutch and transmission life.

NOT INCLUDED IN THE
DIESEL VEHICLE MAINTENANCE
CURRICULUM

TASK AREA: Heavy Equipment

TASK #115: Disassembles and rebuilds pressure plate.

COMPETENCY: Disassemble and reassemble pressure plate following recommended safety practices. Inspect and/or replace parts as needed to bring spring pressure and finger height to manufacturer's specifications.

CRITERION: Can disassemble and reassemble pressure plate assembly so there is no sudden release of spring pressure occurring.

Can inspect pressure plate for cracks, warpage, and heat checks and measure and compare specifications to make decision on machine work or replacements.

Can measure spring height and compression pressure.

Can replace bearings and bushings in finger operating mechanism.

Can reassemble pressure plate parts and adjust operating dimensions to manufacturer's specifications.

SKILL/PROCESS:

1. Use press or other appropriate holding device and disassemble pressure plate from clutch cover
2. Inspect pressure plate for cracks, warpage, and heat checks
3. Inspect condition of springs and measure for height and compression pressure
4. Replace fingers, bearings, bushings, and pins as appropriate
5. Reassemble pressure plate parts and adjust operating dimensions to manufacturer's specification

KNOWLEDGE/THEORY:

1. Function of clutch
2. Use of press and shop tools
   a. Straight edge and feeler gauge
   b. Spring tester
   c. Measuring instruments
3. Disassembly techniques
   a. Angle spring clutches
   b. Diaphragm types
   c. Finger types
4. Cleaning techniques
5. Reassembly techniques
   a. Replace worn parts
   b. Adjust finger height and other internal adjustments

TASK AREA: Power Trains

TASK #116: Relines clutch disc.

COMPETENCY: Inspect disc and hub splines for wear and run-out and lining thickness to determine if within manufacturer's specifications and need of repair.

CRITERION: Can visually inspect lining and determine need to replace old lining.

Can inspect disc for spline wear and warpage with instruments to determine if clutch disc needs replacing.

Can replace new lining by riveting to disc without damaging friction material or disc.

SKILL/PROCESS:

1. Visually inspect lining and disc to determine serviceability
2. Measure spline wear and disc warpage
3. Rivet new lining to disc

KNOWLEDGE/THEORY:

1. Function of clutch
2. Types of friction materials
    a. Metallic
    b. Ceramic
    c. Organic
3. Cleaning techniques
4. Use of measuring tools
5. Inspection
    a. Splines
    b. Hub to disc rivets
    c. Springs
6. Riveting techniques

VALUE/ATTITUDE CONCEPTS: Aware of safety in working with asbestos materials.

TASK AREA: Power Trains

TASK #117: Removes and replaces clutch release bearing.

COMPETENCY: Replace release bearing using correct procedures so bearing will operate properly, have no unusual noises, be greased as appropriate, and will have the correct amount of free travel.

CRITERION: Can secure vehicle and properly remove transmission to gain access to clutch release bearing.

Can determine type of release bearing mechanism and use appropriate equipment and procedure for removal and installation.

Can select proper lubricant and properly lubricate bearing.

Can properly install transmission and adjust release bearing clearances.

SKILL/PROCESS:

1. Use appropriate hoist or jacks to support engine while transmission is removed
2. Remove transmission while taking care not to damage clutch or transmission input shaft
3. Replace release bearing on sleeve on pull-type clutches
4. Disassemble pressure plate assembly and replace bearing in pull-type clutches
5. Pack or pressure lubricate bearing with proper grease
6. Install transmission and adjust clutch brake and adjust clutch release mechanism to manufacturer's specifications

KNOWLEDGE/THEORY:

1. Function of clutch release bearing
2. Types of clutch release bearings
   a. Pull type
   b. Push type
3. Type of engine and transmission mounting
4. Removal and installation procedures
   a. Methods of engine supporting
   b. Techniques of transmission removal
   c. Removal of release bearings
      (1) Pull type
      (2) Push type
5. Lubrication techniques
6. Adjustments
   a. Pressure plate
   b. Linkage

VALUE/ATTITUDE CONCEPTS: Awareness of proper use of transmission jack for supporting and securing transmission.

TASK AREA: Power Trains

TASK #118: Replaces pilot bearing.

COMPETENCY: Remove pilot bearing from housing and check bore to manufacturer's specifications of housing to determine repair needed and replace bearing with correct replacement insuring that bearings run freely.

CRITERION: Can secure vehicle and properly remove transmission and clutch to gain access to pilot bearing.

Can properly remove, clean and inspect bore making recommendation for reuse.

Can properly select, install and lubricate new bearings using correct lubricant.

Can properly install clutch, transmission and related parts.

SKILL/PROCESS:

1. Use appropriate hoists or jacks to support engine while transmission is removed
2. Remove transmission while taking care not to damage clutch or transmission input shaft
3. Remove old bearing, inspect bore and make decision on sleeving or other appropriate repair
4. Pack bearing and bore with grease as appropriate and install new bearing in flywheel or crankshaft
5. Install clutch and transmission and adjust clutch brake and clutch release mechanism to manufacturer's specifications

KNOWLEDGE/THEORY:

1. Clutch operation
2. Securing vehicle
    a. Brakes
    b. Wheel chocks
    c. Jack stands
3. Techniques of transmission removal
    a. Transmission jack, floor crane or chain hoist
    b. Support engine
    c. U-joint phasing
4. Techniques of clutch removal
5. Techniques of pilot bearing removal and installation
    a. Pullers
    b. Inspect and measure bore
    c. Pack bore and bearing with grease
    d. Install bearing

VALUE/ATTITUDE CONCEPTS: Awareness of proper use of transmission jack for supporting and securing transmission.

TASK AREA: Power Trains

TASK #119: Rebuilds 4-or 5-speed manual transmission for medium duty truck.

COMPETENCY: Rebuild 4- and 5-speed manual transmission by replacing worn parts to assure that transmission shifts properly, remains engaged, and has no oil leaks or unusual noises.

CRITERION: Can properly disassemble transmission.

Can properly clean and prepare surfaces for inspection.

Can visually and with proper instruments determine condition of case and parts for reuse.

Can properly select needed parts and reassemble transmission to assure proper engagement, smooth shifting, minimal noise, and no oil leaks.

SKILL/PROCESS:

1. Disassemble transmission, clean parts, and scrape gasket surfaces
2. Use micrometer and dial indicator as needed to determine reusability of parts
3. Install new bearings and thrust washers as needed and assemble internal parts with correct end play and backlash between gears
4. Assemble shift lever housing with needed new parts and install on transmission to assure correct shifting

KNOWLEDGE/THEORY:

1. Operation of transmission
    a. Principles of synchronizer operation
    b. Principles of single countershaft with constant mesh gears
2. Use of shop tools
    a. Hydraulic and arbor presses
    b. Gear pullers
3. Cleaning techniques
4. Disassembly techniques
5. Use of measuring tools
6. Inspection of parts for reuse
    a. Visual inspection
    b. Micrometer or caliper checks
7. Reassembly techniques
    a. Proper clearances on mainshaft and reverse idler
    b. Proper assembly of synchronizers
8. Lubrication techniques

VALUE/ATTITUDE CONCEPTS: Awareness of hazards in hydraulic press operation.

TASK AREA: Power Trains

TASK #120: Rebuilds auxiliary transmission.

COMPETENCY: Rebuild auxiliary transmissions by replacing worn parts to assure that transmission shifts properly, remains engaged, and has no oil leaks or unusual noises.

CRITERION: Can properly disassemble auxiliary transmission.

Can properly clean and prepare surfaces for inspection.

Can visually and with proper instruments determine condition of case and internal parts for reuse.

Can properly select needed parts and reassemble auxiliary transmission to assure proper engagement, smooth shifting, minimal noise, and no oil leaks.

SKILL/PROCESS:

1. Disassemble transmission, clean parts and scrape gasket surfaces
2. Use micrometer and dial indicator as needed to determine reusability of parts
3. Install new bearings and thrust washers as needed and assemble internal parts with correct end play and backlash between gears
4. Assemble shift lever housing with needed new parts and install on transmission to assure correct shifting

KNOWLEDGE/THEORY:

1. Operation of transmission
   a. Principles of synchronizer operation
   b. Principles of single countershaft with constant mesh gears
2. Use of shop tools
   a. Hydraulic and arbor presses
   b. Gear pullers
3. Cleaning techniques
4. Disassembly techniques
5. Use of measuring tools
6. Inspection of parts for reuse
   a. Visual inspection
   b. Micrometer or caliper checks
7. Reassembly techniques
   a. Proper clearances on mainshaft
   b. Proper assembly of synchronizers
8. Lubrication techniques

VALUE/ATTITUDE CONCEPTS: Awareness of hazards in operation of hydraulic press.

TASK AREA: Power Trains

TASK #121: Removes and replaces transmission air shift mechanisms.

COMPETENCY: Remove and replace transmission air shift mechanisms following manufacturer's recommended procedures so that transmission shifts properly without air leaks.

CRITERION: Can remove air shift mechanism and identify air lines so lines can be replaced in correct locations.

Can install new air shift mechanism, attaching air line so as to assure proper transmission shifting without air leaks.

SKILL/PROCESS:

1. Disconnect all air lines without damage to fittings.
2. Remove valves, filters and other components.
3. Install new components and hook up lines.
4. Build up air pressure and shift transmission and check for leaks.

KNOWLEDGE/THEORY:

1. Operation of air shift
   a. Air filter
   b. Pressure regulator
   c. Range shift
   d. Splitter shift
2. Use of plastic air tubing and fittings
3. Cleaning techniques
4. Disassembly and reinstallation techniques
   a. Inspect for damage or cause of any failures
   b. Inspect for worn tubing
   c. Lubrication techniques
5. Testing system operation

VALUE/ATTITUDE CONCEPTS: See general list on Page 11.

TASK AREA: Power Trains

TASK #122: Rebuilds air shift mechanism.

COMPETENCY: Rebuild air shift mechanism following manufacturer's recommended procedures to assure the transmission will shift properly and have no air leaks.

CRITERION: Can properly disassemble, clean and inspect air shift mechanism.

Can select proper repair parts and assemble air shift mechanism with proper parts and lubricating to prevent damage to "o" rings and gaskets as they are installed.

SKILL/PROCESS:

1. Disassemble, clean, and inspect valves, filters, and cylinders as appropriate
2. Select replacement parts and assemble components using appropriate grease or silicone lubricant on o-rings
3. Test parts as needed to assure no air leaks

KNOWLEDGE/THEORY:

1. Operation of air shift
   a. Air filter
   b. Pressure regulator
   c. Range shift
   d. Splitter shift
2. Use of plastic air tubing and fittings
3. Disassembly techniques
   a. Inspect for damage or cause of any failures
   b. Inspect for worn tubing
4. Cleaning techniques
5. Reassembly techniques
   a. Lubrication
   b. Installation of o-rings
   c. Testing system operation

VALUE/ATTITUDE CONCEPTS: See general list on Page 11.

TASK AREA: Power Trains

TASK #123: Overhauls twin countershaft transmission.

COMPETENCY: Rebuild twin countershaft transmission by replacing worn parts to assure that transmission shifts properly, remains engaged and has no oil leaks or unusual noises.

CRITERION: Can properly disassemble transmission.

Can properly clean and prepare surfaces for inspection.

Can visually and with proper instruments determine condition of case and internal parts for reuse.

Can properly locate and identify teeth on counter shaft, drive and driven gears and time to operate to assure smoothness of operation without binding.

Can properly select needed parts and reassemble transmission to assure proper engagement, smooth shifting, minimal noise, and no oil leaks.

SKILL/PROCESS:

1. Disassemble transmission, clean parts, and gasket surfaces
2. Use micrometer and dial indicator as needed to determine reusability of parts
3. Use appropriate thrust washers to attain correct end play between gears while assembling mainshaft
4. Install and correctly time main drive gear and countershafts
5. Assemble remainder of transmission and shift lever housing to assure correct shifting

KNOWLEDGE/THEORY:

1. Operation of transmission
   a. Principles of unsynchronized gearing
   b. Operation of air shift system
   c. Principles of constant mesh gears
   d. Principles of synchronizer operation
2. Use of shop tools
   a. Hydraulic and arbor presses
   b. Gear pullers
3. Cleaning techniques
4. Disassembly techniques
5. Use of measuring tools
6. Inspection of parts for reuse
   a. Visual inspection
   b. Micrometer or caliper checks
7. Reassembly techniques
   a. Proper clearances on mainshaft
   b. Proper timing of countershafts
   c. Proper assembly of synchronizer
8. Lubrication techniques

VALUE/ATTITUDE CONCEPTS: Awareness of following correct procedure.

TASK AREA: Power Trains

TASK #124: Overhauls three countershaft transmission.

COMPETENCY: Rebuild three countershaft transmission by replacing worn parts to assure that transmission shifts properly, remains engaged, and has no oil leaks or unusual noises.

CRITERION: Can properly disassemble transmission.

Can properly clean and prepare surfaces for inspection.

Can visually and with proper instruments determine condition of case and internal parts for reuse.

Can properly locate and identify teeth to be timed and time shafts to assure smoothness of operation without binding.

Can properly select needed parts and reassemble transmission to assure proper engagement, smooth shifting, minimal noise and no oil leaks.

SKILL/PROCESS:

1. Clean transmission for disassembly
2. Disassemble transmission in sequence according to manufacturer's procedures
3. Clean parts
4. Check all parts visually for wear and damage
5. Measure all parts to determine if within manufacturer's specifications
6. Select replacement parts
7. Mark gear teeth for timing
8. Reassemble and time countershafts and allow for correct clearances
9. Replace covers using correct gaskets and seals
10. Check shifting of transmission

KNOWLEDGE/THEORY:

1. Operation of transmission
    a. Principles of unsynchronized gearing
    b. Principles of constant mesh gears
2. Use of shop tools
    a. Hydraulic and arbor presses
    b. Gear pullers
3. Cleaning techniques
4. Disassembly techniques
5. Inspection of parts for reuse
    a. Visual inspection
    b. Micrometer or caliper checks
6. Use of measuring tools
7. Reassembly techniques
    a. Proper clearances on mainshaft
    b. Proper timing of countershafts
8. Lubrication techniques

VALUE/ATTITUDE CONCEPTS: Awareness of following correct procedures.

TASK AREA: Power Trains

TASK #125: Replaces transmission input shaft separate from transmission overhaul.

COMPETENCY: Remove and replace the input shaft without major disassembly of the transmission following recommended procedures.

CRITERION: Can properly remove bearing retainer, drive gear nut, and input shaft.

Can properly install new shaft, torquing drive gear nut and install gaskets and seals to assure no oil leakage.

SKILL/PROCESS:

1. Remove bearing retainer, drive gear nut, and input shaft.
2. Install new input shaft and torque gear nut.
3. Install gasket and seals to assure no oil leaks.

KNOWLEDGE/THEORY:

1. Operation of transmission
2. Operation of clutch
    a. Pressure plate and release bearing
    b. Clutch disc(s) and transmission input shaft
3. Disassembly techniques
    a. Clutch bell housing
    b. Main drive gear nut and snap ring
    c. Main shaft pocket bearing
    d. Front bearing retainer
4. Cleaning techniques
5. Reassembly techniques
    a. Mainshaft pocket bearing correctly installed
    b. Main drive gear nut torqued and staked

VALUE/ATTITUDE CONCEPTS: See general list on Page 11.

TASK AREA: Power Trains

TASK #126: Replaces speedometer drive gear separate from transmission overhaul.

COMPETENCY: Replace speedometer drive gear with transmission mounted in truck following recommended procedures to assure that speedometer operates smoothly, accurately, and without oil leaks.

CRITERION: Can disassemble u-joints and swing driveline out of the way.

Can remove u-joint yoke or companion flange from transmission.

Can remove seal retainer if necessary and remove speedometer drive gear.

Can identify gear by width and number of teeth and procure correct replacement.

Can install gear, seal retainer, and u-joint yoke using correct torque on output shaft nut.

Can install driveline with correct u-joint phasing.

SKILL/PROCESS:

1. Disassemble u-joints and driveline from vehicle
2. Remove yoke or companion flange
3. Remove seal retainer and speedometer drive gear
4. Identify gear width and number of teeth for correct replacement
5. Replace gear, seal retainer, and yoke
6. Torque output shaft nut
7. Replace driveline with correct u-joint phasing.

KNOWLEDGE/THEORY:

1. Operation of transmission
2. Principles of u-joint and driveline operation
3. Disassembly techniques for u-joints
4. Disassembly techniques for transmission output yoke
5. Cleaning techniques
6. Gear ratios of speedometer gear sets
7. Reassembly techniques for transmission
8. Reassembly and phasing of u-joints

VALUE/ATTITUDE CONCEPTS: Awareness of correct procedures for torquing and replacement of correct parts to assure accurate operation of speedometer.

TASK AREA: Power Trains

TASK #127: Removes and replaces shift lever housing from transmission separate from transmission overhaul.

COMPETENCY: Remove and reinstall the shift lever housing so transmission will shift properly in all gears and there are no oil leaks.

CRITERION: Can remove shift lever housing without allowing foreign matter to enter transmission.

Can install housing with shift forks correctly engaged with gears or synchronizers.

SKILL/PROCESS:

1. Remove shift lever housing from transmission
2. Cover transmission to keep out foreign matter
3. Install shift lever housing with shift forks correctly engaged with gear or synchronizer

KNOWLEDGE/THEORY:

1. Operation of transmission
2. Operation of shift lever housing
   a. Function of shift rods and poppet balls
   b. Function of interlock pins
3. Removal techniques (prevent entry of dirt into transmission)
4. Cleaning techniques
5. Reinstallation procedures
   a. Poppet balls and springs in place
   b. Gears or synchronizers in neutral
   c. Wires and air lines correctly connected
6. Test shifting operation

VALUE/ATTITUDE CONCEPTS: See general list on Page 11.

TASK AREA: Power Trains

TASK #128: Rebuild shift lever housing.

COMPETENCY: Rebuild shift lever housing according to recommended procedures so that shift lever does not bind or have looseness, shifts smoothly, remains engaged, and there are no oil leaks.

CRITERION: Can disassemble housing and clean and inspect all parts to determine parts to be repaired or replaced.

Can reassemble housing using replacement balls, springs, pins, forks and shift rails as necessary.

Can test shift housing on work bench to verify proper operation.

SKILL/PROCESS:

1. Disassemble housing and clean
2. Inspect parts for repairs or reuse
3. Reassemble housing replacing balls, springs, pins, forks, or shift rails
4. Test for proper shifting

KNOWLEDGE/THEORY:

1. Operation of transmission
2. Operation of shift lever housing
    a. Function of shift rods and poppet balls
    b. Function of interlock pins
3. Disassembly techniques
4. Cleaning techniques
5. Inspection of parts for reusability
6. Reassembly techniques

VALUE/ATTITUDE CONCEPTS: See general list on Page 11.

TASK AREA: Power Trains

TASK #129: Removes and replaces remote shifter.

COMPETENCY: Remove and replace remote shifter following recommended procedures so there is no binding in shifter linkage and the transmission will shift properly in all gears and the shifter will mate with the opening in the cab floor and allow no drafts or excessive noises to enter the cab.

CRITERION: Can properly remove remote shifter.

Can properly install remote shifter to assure no linkage binding or interference with cab.

Can safety wire set screws in u-joint yokes.

SKILL/PROCESS:

1. Raise cab and secure for proper safety
2. Remove air or electric lines
3. Disconnect u-joint from transmission remote shaft
4. Unbolt shifter from frame or transmission
5. Bolt shifter to frame or transmission
6. Safety wire set screws.
7. Connect remote shaft and check for binding or cab interference
8. Connect air or electric lines

KNOWLEDGE/THEORY:

1. Safe working practices for cab-over trucks
2. Operation of transmission
3. Operation of remote shifting mechanism
4. Removal techniques
    a. Engine mounting
    b. Frame mounting
5. Installation techniques
    a. Alignment with cab floor opening
    b. Adjustment of shift rod with transmission shift tower
    c. Correct hook up of air lines and electric wires
6. Testing for proper shifting

VALUE/ATTITUDE CONCEPTS: See general list on Page 11.

TASK AREA: Power Trains

TASK #130: Repairs remote shifter.

COMPETENCY: Repair remote shifter by disassembling and repairing damaged part to eliminate binding and facilitate smooth shifting.

CRITERION: Can properly disassemble and clean remote shifter.

Can visually and with proper instruments determine worn parts.

Can properly make needed repairs to worn or damaged parts.

Can properly assemble remote shifter with serviceable parts, adjust to assure no binding, and facilitate smooth shifting.

SKILL/PROCESS:

1. Disassemble and clean shifter
2. Inspect parts and measure shaft to determine if within specifications
3. Weld pivot slot or replace shift stick
4. Weld or replace horizontal shaft
5. Replace seals and bushings
6. Reassemble shifter and check for smooth operation

KNOWLEDGE/THEORY:

1. Operation of transmission
2. Operation of remote shifting mechanism
3. Disassembly techniques
    a. Air and electric lines
    b. U-joints and yokes
    c. Shift lever and horizontal shaft
    d. Shaft bushings
4. Cleaning techniques
5. Inspection of parts for reuse
6. Repair of parts
    a. Welding
    b. Straightening bent rods
    c. Grinding
7. Reassembly techniques
    a. No lost motion in lever and shaft
    b. Smoothness and ease of operation
8. Lubrication techniques

VALUE/ATTITUDE CONCEPTS: See general list on Page 11.

TASK AREA: Power Trains

TASK #131: Removes and replaces automatic transmission.

COMPETENCY: Remove and replace automatic transmission following recommended safety practices and procedures, making sure transmission does not leak and that linkages are adjusted properly for transmission shifting.

CRITERION:

Can prepare automatic transmission for removal using safety procedures and equipment.

Can remove driveline without damage to u-joints or yokes.

Can remove transmission without damage to torque converter, transmission input shaft or seals.

Can install transmission without damage to components and with bolts properly torqued.

Can install linkages in proper location and install oil lines to insure no leaks.

Can service automatic transmission with proper lubricants.

Can road test vehicle to verify proper transmission operation.

SKILL/PROCESS:

1. Disconnect u-joint and move driveline out of work area
2. Remove transmission without damaging torque converter
3. Install transmission without damaging components or seals
4. Torque transmission mounting bolts
5. Install linkages and oil lines
6. Add proper transmission fluid if necessary
7. Road test vehicle

KNOWLEDGE/THEORY:

1. Safety practices
    a. Brakes
    b. Wheel chocks
    c. Jack stands
2. Operation of u-joints and driveline
3. Operation of automatic transmissions
    a. Transmission pan, filter, and lines
    b. Torque converter
    c. Input shaft and seals
4. Use of shop tools
    a. Transmission jack
    b. Chain fall
    c. Floor crane
5. Removal techniques
    a. Driveline
    b. Oil lines
    c. Linkages
    d. Torque converter mounting

6. Installation techniques
    a. Torque converter and input shaft line up
    b. Torquing procedures
    c. Oil lines
    d. Linkages
    e. U-joint phasing
    f. Transmission oil level
7. Road test
    a. Shift performance
    b. Oil temperature
    c. Vibrations

VALUE/ATTITUDE CONCEPTS: Awareness of safety and proper procedures in removing transmission.

TASK AREA: Power Trains

TASK #132: Rebuilds automatic and/or power shift transmissions.

COMPETENCY: Rebuild automatic and/or power shift transmissions to manufacturer's specifications by replacing worn parts to assure that transmission shifts properly, remains engaged, and has no oil leaks or unusual noises.

CRITERION: Can disassemble transmission without damage to case or internal parts.

Can clean and inspect parts and make decision on reuse.

Can identify parts and obtain proper replacements.

Can reassemble transmission making all required adjustments according to specifications.

Can run transmission on test stand to check for shift points, noises and leaks.

SKILL/PROCESS:

1. Disassemble transmission
2. Clean internal parts and case
3. Inspect parts for reuse
4. Identify needed parts and obtain replacements
5. Reassemble transmission making all required adjustments according to manufacturer's specifications
6. Fill transmission with proper fluid to correct level
7. Run transmission on test stand and check performance according to specifications
8. Check for leaks

KNOWLEDGE/THEORY:

1. Operation of transmission
   a. Hydraulics
   b. Properties of transmission oils
   c. Gearing
   d. Friction materials
2. Disassembly techniques
3. Cleaning techniques
4. Inspection of parts for reuse
5. Reassembly techniques
   a. Torquing techniques
   b. Lubrication techniques
   c. Band and other adjustments
6. Operation of transmission test stand
   a. No oil leaks on transmission
   b. Stall tests
   c. Shift points
   d. No unusual noises

VALUE/ATTITUDE CONCEPTS: Awareness of cleanliness.

Awareness of critical torque values.

TASK AREA: Power Trains

TASK #133: Rebuilds torque converter. (Non-sealed units)

COMPETENCY: Rebuild torque converter to manufacturer's specification and test converter on test stand to determine if performing according to specified rating.

CRITERION: Can disassemble torque converter without damaging internal parts.

Can inspect parts and make decision on reuse.

Can identify parts and procure correct replacements.

Can reassemble torque converter and test for operation according to manufacturer's specifications.

SKILL/PROCESS:

1. Disassemble torque conversion without damage to internal parts
2. Inspect parts for reuse
3. Identify part for correct replacement
4. Reassemble torque converter
5. Test for operation according to manufacturer's specifications

KNOWLEDGE/THEORY:

1. Operation of torque converter
   a. Stator
   b. Turbine
   c. One-way clutch
   d. Bushings
2. Disassembly techniques
3. Cleaning techniques
4. Inspection of parts for reuse
5. Reassembly techniques
   a. Lubrication techniques
   b. Torquing techniques
6. Testing

VALUE/ATTITUDE CONCEPTS: Awareness of cleanliness.

Awareness of critical torque values.

TASK AREA: Power Trains

TASK #134: Removes and reinstalls driveline.

COMPETENCY: Remove and replace driveline without damage to center bearings or u-joints and with u-joints correctly phased.

CRITERION: Can properly remove driveline assuring the protection of u-joint bearings and center bearing mount.

Can visually inspect and check driveline tube, spline, and u-joints and make decisions on needed repair.

Can properly install driveline assuring correct phasing and installation of u-joint and correct angularity.

SKILL/PROCESS:

1. Remove driveline while protecting u-joint bearings and center bearing mounts
2. Inspect driveline tube and spline
3. Inspect u-joints for reuse
4. Install driveline
5. Phase u-joints and check angularity

KNOWLEDGE/THEORY:

1. Operation of u-joints
   a. Angles
   b. Phasing
   c. Bearings
2. Operation of center bearings and slip splines
3. Removal techniques
   a. Use of pullers
   b. Use of jacks
4. Cleaning techniques
5. Inspect parts for reuse
   a. Dents in driveline tube
   b. Bent tubes
   c. u-joint bearings
   d. u-joint bearing journals
   e. Damaged yokes
   f. Spline wear
   g. Center bearing wear
6. Reassembly techniques
   a. Lubrication
   b. Phasing u-joints
   c. u-joint angles
   d. Center bearing positioning

VALUE/ATTITUDE CONCEPTS: Awareness of criticality of phasing and grease fitting alignment.

TASK AREA: Power Trains

TASK #135: Sets angularity of driveline.

COMPETENCY: Use protractor and appropriate tools to check angularity of driveline and to adjust to within manufacturer's specifications so there is no vibration.

CRITERION: Can select proper tools, instruments and specification for model of vehicle.

Can properly measure driveline angularity and adjust to within manufacturer's specifications.

SKILL/PROCESS:

1. Select proper tools
2. Select instruments and specifications for vehicle model
3. Measure drive line angularity
4. Adjust to manufacturer's specifications

KNOWLEDGE/THEORY:

1. Operation of u-joints
2. Operation of slip splines
3. Use of special tools
    a. Protractor
    b. Level
4. Measuring techniques
    a. Park vehicle on level floor
    b. Correct tire pressure
    c. Transmission inclination
    d. Driveline inclination
    e. Rear axle inclination
    f. Rear axle horizontal offset
5. Adjust angles
    a. Shim transmission mounts
    b. Shim torque arms on tandem axles
    c. Wedges under rear springs

VALUE/ATTITUDE CONCEPTS: See general list on Page 11.

TASK AREA: Power Trains

TASK #136: Removes and replaces universal joints.

COMPETENCY: Remove and replace u-joints using recommended practices so joints will flex freely.

CRITERION: Can select proper tools for removal of joints to assure no damage to yokes.

Can select correct u-joint parts and properly install u-joints to assure free flexing and correct phasing.

Can select proper lubricant and lubricate completed driveline and joints.

SKILL/PROCESS:

1. Select proper tools
2. Remove u-joints with press, puller, or vise to assure no damage to yokes
3. Select correct u-joints and parts
4. Properly install u-joint for free flexing and correct phasing
5. Select lubricant and lubricate driveline u-joints

KNOWLEDGE/THEORY:

1. Function of u-joints
2. Use of shop tools
    a. Press
    b. Pullers
    c. Vice
3. Disassembly techniques
    a. U-bolts or cap screws
    b. Press bearing caps out of yokes (don't hammer)
4. Selection of parts
    a. Manufacturer
    b. Size
5. Reassembly techniques
    a. Yoke is straight
    b. Grease fitting properly positioned
    c. Press bearing caps into yoke (don't hammer)
    d. Torque screws and nuts
    e. Lubricate
    f. Free movement of assembled joint
    g. U-joint phasing

VALUE/ATTITUDE CONCEPTS: Awareness of criticality of phasing and grease fitting alignment.

TASK AREA: Power Trains

TASK #137: Removes and replaces yoke. (Driveline removed)

COMPETENCY: Remove and replace with correct yoke to manufacturer's specifications and without oil leaks.

CRITERION: Can properly remove yoke without damage to seals.

Can select proper replacement parts.

Can properly install yoke torquing to manufacturer's specifications.

SKILL/PROCESS:

1. Remove yoke without damage to seals
2. Select proper parts
3. Install yoke and torque retaining nut to manufacturer's specifications

KNOWLEDGE/THEORY:

1. Function of u-joints
2. Removal techniques
    a. Slotted nuts
    b. Self-locking nuts
    c. Yoke pullers
3. Cleaning techniques
4. Selection of parts
    a. Manufacturer
    b. Size of u-joint
5. Installation techniques
    a. Lubrication
    b. Align cotter pin hole
    c. Torquing nut

VALUE/ATTITUDE CONCEPTS: Awareness of critical torque values.

TASK AREA: Power Trains

TASK #138: Removes and replaces driveline center bearings.

COMPETENCY: Remove and replace driveline center bearing following manufacturer's specifications so driveline will produce no vibrations or unusual noises.

CRITERION: Can remove driveline assembly without damage to driveline components for access to bearing and shaft.

Can remove bearing by pressing off drive shaft without damaging drive shaft.

Can press new bearing on without damaging bearing or shaft.

Can install rubber cushion and steel hanger correctly.

Can install yoke correctly phased.

SKILL/PROCESS:

1. Remove driveline
2. Remove bearing with press or puller being careful not to damage driveline
3. Press on new bearing
4. Install hanger and rubber cushion correctly
5. Install driveline and properly phase u-joints

KNOWLEDGE/THEORY:

1. Function of u-joints
2. Function of center bearing and drive shaft
3. Use of pullers and shop press
4. Disassembly of u-joints
5. Removal techniques for bearing
6. Installation and assembly of bearing and bearing support
7. Phasing and reassembly of u-joints

VALUE/ATTITUDE CONCEPTS: See general list on Page 11.

TASK AREA: Power Trains

TASK #139: Removes and replaces rear differential carrier assembly in tandem.

COMPETENCY: Remove and replace rear differential carrier assembly following manufacturer's recommended procedures and specifications so that assembly does not leak.

CRITERION: Can properly remove and install driveline and axles to facilitate removal of carrier assembly.

Can properly support and remove carrier assembly (top mount - front mount)

Can properly clean and visually inspect sealing areas.

Can properly install carrier assembly using recommended sealant and procedure to assure proper functioning and no leakage.

Can select proper lubricant and fill to recommended level.

SKILL/PROCESS:

1. Remove driveline and axles
2. Support carrier assembly and remove top mount or front mount types
3. Clean and inspect sealing areas
4. Using recommended procedure install carrier assembly
5. Fill to recommended level with correct lubricant and inspect for leaks

KNOWLEDGE/THEORY:

1. Function of differential carrier assembly
2. Principles of driveline angles and torque arm function
3. Operation of u-joints
4. Removal of axle shafts
5. Removal of torque arm and shims
6. Use of transmission jack, floor crane, chain hoist
7. Cleaning techniques
8. Gasket materials and sealing compounds
9. U-joint phasing
10. Types of lubricants

VALUE/ATTITUDE CONCEPTS: See general list on Page 11.

TASK AREA: Power Trains

TASK #140: Rebuilds rear differential carrier assembly.

COMPETENCY: Rebuilds rear differential carrier assembly following manufacturer's procedures and specifications so that carrier will operate properly with no unusual noises and without oil leakage. Two-speed units will shift properly.

CRITERION: Can properly disassemble carrier assembly being sure to keep shims with cages, cups with cones and assemblies "match-marked."

Can properly clean parts.

Can visually and with proper instruments check parts for wear and damage.

Can properly select the placement parts and assemble carrier assembly to assure bearing preloads, gear clearances and tooth pattern are within manufacturer's specifications so carrier will operate with no unusual noises or oil leakage.

Can properly install two-speed shift unit to shift properly.

SKILL/PROCESS:

1. Disassemble carrier assembly being sure to keep "mated" parts together
2. Clean parts and inspect for wear and damage
3. Select replacement parts
4. Assemble carrier being sure to adjust all parts and assemblies to manufacturer's specifications
5. Install two-speed shift unit if equipped

KNOWLEDGE/THEORY:

1. Operation of differential carrier assembly
2. Disassembly procedures
    a. Prevention of damage to wearing surfaces
    b. Match-marking
    c. Mated parts
    d. Use of press and pullers
3. Cleaning techniques
    a. Hot tank
    b. Cold tank
    c. Glass bead blasting
    d. Solvent and brush
4. Reassembly procedures
    a. Thrust washers
    b. Mated parts
    c. Bearing preload
    d. Backlash and gear tooth contact pattern
    e. Torques

VALUE/ATTITUDE CONCEPTS: Aware of criticality of keeping mated parts together.

TASK AREA: Power Trains

TASK #141: Removes and reinstalls front differential carrier assembly in tandem.

COMPETENCY: Remove and replace rear differential carrier assembly in tandem following manufacturer's recommended procedures and specifications so that there are no leaks. Power divider must function properly. Speed shifting mechanisms must function in two-speed assemblies.

CRITERION: Can remove driveline and axle shafts to facilitate removal of carrier.

Can disconnect shifting mechanism and remove thru-shaft.

Can support and remove carrier assembly (top or front mount).

Can clean mating surfaces and visually inspect for damage.

Can install carrier, shift mechanisms and thru-shaft using a recommended sealant to insure there will be no leakage and carrier will function properly.

Can select proper lubricant and fill to recommended level.

SKILL/PROCESS:

1. Remove driveline and axles
2. Disconnect shift mechanism and thru-shaft
3. Remove top or front mount carrier assembly
4. Clean surfaces and inspect for damage
5. Install carrier assembly
6. Replace shift mechanism and thru-shaft
7. Select lubricant and fill to recommended level (including power divider).
8. Check for leaks

KNOWLEDGE/THEORY:

1. Function of differential carrier assembly
2. Principles of torque arm and driveline angles
3. Operation of u-joints
4. Axle shaft removal techniques
5. Techniques of torque arm and shim removal
6. Use of transmission jack, floor crane, chain hoist
7. Cleaning techniques
8. Gasket materials and sealing compounds
9. U-joint phasing
10. Types of lubricants

VALUE/ATTITUDE CONCEPTS: See general list on Page 11.

TASK AREA: Power Trains

TASK #142: Rebuilds front differential carrier assembly.

COMPETENCY: Rebuild front carrier assembly following manufacturer's specifications so that carrier will operate properly with no unusual noises and without oil leakage. Two-speed units must shift properly and power divider will engage and disengage.

CRITERION: Can properly disassemble carrier assembly being sure to keep shims with cage, cups with cones, and match-mark appropriate parts.

Can clean and inspect parts for wear and damage.

Can select replacement parts and assemble carrier to assure bearing preload, gear clearances and tooth pattern are within manufacturer's specifications so that carrier will operate with no unusual noises or oil leakage.

Can install inter-axle differential lock unit so it will lock in and out properly.

Can install two-speed shift unit so that it will shift properly.

SKILL/PROCESS:

1. Disassemble carrier assembly being sure to keep "mated" parts together
2. Clean parts and inspect for wear and damage
3. Select replacement parts
4. Assemble carrier being sure to adjust bearing preload, gear clearances and tooth pattern to manufacturer's specifications
5. Install inter-axle differential lock unit
6. Install two-speed shift unit if equipped

KNOWLEDGE/THEORY:

1. Operation of differential carrier assembly
2. Disassembly procedures
   a. Prevention of damage to wearing surfaces
   b. Match-mark and keep "mated" parts together
   c. Use of press and pullers
3. Cleaning techniques
   a. Hot tank
   b. Cold tank
   c. Glass bead blasting
   d. Solvent and brush
4. Reassembly procedures
   a. Thrust washers
   b. "Mated" parts
   c. Bearing preload
   d. Backlash and gear tooth contact pattern
   e. Torques
   f. Power divider lock out

VALUE/ATTITUDE CONCEPTS: See general list on Page 11.

TASK AREA: Power Trains

TASK #143: Removes and reinstalls inter-axle differential.

COMPETENCY: Remove and replace inter-axle differential with differential carrier in the vehicle following manufacturer's procedures and specifications so that unit will engage and disengage properly and there will be no oil leaks.

CRITERION: Can properly remove driveline to facilitate inter-axle differential removal.

Can remove inter-axle differential following manufacturer's procedures.

Can properly clean and visually inspect housing for damage.

Can properly install inter-axle differential using recommended sealant to assure no leakage.

Can select proper lubricant and fill to recommended level.

SKILL/PROCESS:

1. Remove driveline
2. Remove inter-axle differential
3. Clean and inspect housing exterior for damage
4. Install inter-axle differential
5. Select lubricant and fill to recommended level

KNOWLEDGE/THEORY:

1. Function of differential carrier assembly with inter-axle differential
2. Operation of u-joints
3. U-joint disassembly techniques
4. Inter-axle differential removal techniques
    a. Lock out unit
    b. Cleaning
5. Installation techniques
    a. Gaskets and sealers
    b. Lock out unit
    c. Lubrication (fill unit with gear oil)
6. U-joint installation
    a. Phasing
    b. Lubrication

VALUE/ATTITUDE CONCEPTS: Awareness of proper lubrication procedures.

TASK AREA: Power Trains

TASK #144: Rebuilds inter-axle differential.

COMPETENCY: Rebuild inter-axle differential to manufacturer's procedures and specifications so unit will operate with no unusual noises and will not leak.

CRITERION: Can properly disassemble inter-axle differential match-marking case.

Can properly clean and visually inspect for wear and damage and make decision on replacement.

Can properly select needed parts and assemble to manufacturer's specifications.

SKILL/PROCESS:

1. Disassemble inter-axle differential marking case for reassembly
2. Clean and inspect for wear and damage
3. Select replacement parts
4. Assemble inter-axle differential to manufacturer's specifications

KNOWLEDGE/THEORY:

1. Operation of differential carrier assembly
2. Operation of inter-axle differential
3. Cleaning techniques
    a. Hot tank
    b. Cold tank
    c. Solvent and brush
4. Disassembly and reassembly techniques
    a. Use of press and pullers
    b. Match-mark "mated" parts
    c. Torquing

VALUE/ATTITUDE CONCEPTS: See general list on Page 11.

TASK AREA: Power Trains

TASK #145: Rebuilds limited slip differential.

COMPETENCY: Rebuild limited slip differential to manufacturer's specifications so that unit will operate properly without unusual noises and oil leakage.

CRITERION: Can disassemble carrier assembly keeping shims, bearings, and clutches matched in order of disassembly.

Can clean, inspect and determine parts for reuse.

Can reassemble carrier to insure clearances according to manufacturer's specifications so that unit will function and have no unusual noises or oil leaks.

SKILL/PROCESS:

1. Disassemble carrier assembly being sure to keep "mated" parts together
2. Clean parts and inspect for reuse
3. Reassemble carrier being sure to adjust clearances and backlash to meet manufacturer's specifications

KNOWLEDGE/THEORY:

1. Operation of non-limited slip differential
2. Operation of limited slip differential
3. Disassembly procedures
   a. Prevention of damage to wearing surfaces
   b. Match-mark and keep "mated" parts together
   c. Use of press and pullers
4. Cleaning techniques
   a. Hot tank
   b. Cold tank
   c. Solvent and brush
5. Reassembly procedures
   a. Thrust washers
   b. "Mated" parts
   c. Springs and clutches
   d. Bearing preload
   e. Backlash and gear tooth contact pattern

VALUE/ATTITUDE CONCEPTS: See general list on Page 11.

TASK AREA: Power Trains

TASK #146: Replaces pinion seal separate from carrier overhaul.

COMPETENCY: Replace pinion seal following manufacturer's procedure so gaskets and seals will not leak.

CRITERION: Can remove driveline to facilitate yoke removal.

Can properly remove yoke (seal retainer if applicable) and seal.

Can properly clean and inspect for damage.

Can properly install seal, gaskets and yoke and torque nuts to manufacturer's specifications to assure proper functioning and no leakage.

SKILL/PROCESS:

1. Remove driveline
2. Remove yoke, seal retainer, and seal
3. Clean and inspect yoke for damage
4. Install seal, gasket, and yoke
5. Torque nut to manufacturer's specifications
6. Check for proper functioning and leakage

KNOWLEDGE/THEORY:

1. Operation of differential carrier assembly
2. Operation of u-joints
3. U-joint disassembly techniques
4. Use of air tools and pullers
5. Principles of seal replacement
    a. Nut and yoke removal
    b. Seal removal
    c. Inspection of yoke and seal bore
    d. Seal installation and lubrication
    e. Torquing

VALUE/ATTITUDE CONCEPTS: Awareness of critical torque values.

TASK AREA: Power Trains

TASK #147: Removes and reinstalls two-speed shift unit.

COMPETENCY: Remove and replace two-speed shift unit following manufacturer's procedures so unit will shift and will not have oil leaks.

CRITERION:

Can check air unit for leaks and make decision on replacing or overhauling.

Can remove electrical wires or air lines without damage to wires or air fittings.

Can check shifting fork for free movement.

Can install two-speed unit making sure fork is engaged.

Can check unit for proper electric and air connection to assure low and high range shift.

Can check electric unit oil reservoir for proper oil level and refill with correct oil.

SKILL/PROCESS:

1. Check air unit for leaks and make decision on needed work
2. Remove electrical wires or air lines
3. Check shift fork for free movement
4. Reinstall shift unit making sure shift fork is engaged
5. Hook up air or electric lines
6. Check for proper high and low range shift
7. Check electric unit's oil reservoir
8. Fill with correct oil

KNOWLEDGE/THEORY:

1. Operation of differential carrier assembly
2. Operation of two-speed unit
   a. Air
   b. Electric
3. Removal and installation procedures
   a. Air and electric lines
   b. Free movement of mechanism on vehicle
   c. Engagement of shift fork in carrier
   d. Lubrication techniques
   e. Proper shifting

VALUE/ATTITUDE CONCEPTS: See general list on Page 11.

TASK AREA: Power Trains

TASK #148: Rebuilds two-speed shift unit.

COMPETENCY: Rebuild two-speed shift unit to manufacturer's specifications and test unit to determine if operating properly.

CRITERION: Can disassemble and inspect parts of electric unit and make decision on parts replacement.

Can select correct replacement parts, install, and align.

Can test unit with battery to verify proper operation.

Can disassemble air unit and inspect parts.

Can reassemble and test for proper operation and no air leaks.

SKILL/PROCESS:

1. Disconnect electrical wiring
2. Disassemble electric two-speed units
3. Inspect parts for replacement
4. Select correct replacement parts
5. Install parts and align bearings for freeness
6. Test unit with battery to verify proper operation
7. Disassemble air unit and inspect parts
8. Reassemble unit with new diaphragm
9. Check for air leaks

KNOWLEDGE/THEORY:

1. Operation of differential carrier assembly
2. Operation of two-speed unit
    - a. Air
    - b. Electric
3. Principles of electricity
    - a. Voltage
    - b. Amperage
    - c. Resistance
4. Techniques of electrical test on DC motors
    - a. Amperage draw
    - b. Open circuits
    - c. Ground circuits
5. Mechanical checks
    - a. Bushing and bearing wear
    - b. Housing damage
    - c. Spring tension
    - d. Condition of diaphragm
    - e. Condition of clamps
    - f. Brushes and commutator

VALUE/ATTITUDE CONCEPTS: See general list on Page 11.

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TASK AREA: Power Trains

TASK #149: Removes and reinstalls front drive axle transfer case.

COMPETENCY: Remove and replace transfer case using recommended safety practices and procedures checking to assure shift mechanism operates according to manufacturer's recommendations.

CRITERION: Can properly secure vehicle for transfer case removal.

Can properly disconnect linkages and drivelines.

Can select proper tools and equipment to facilitate removal and installation of transfer case.

Can properly reassemble linkages and drivelines to operate according to manufacturer's recommendations.

SKILL/PROCESS:

1. Secure vehicle for safe removal of transfer case
2. Disconnect shift linkages and drivelines
3. Select appropriate transmission jack and remove transfer case
4. Reinstall transfer case
5. Hook up shift linkage
6. Hook up drivelines correctly phased
7. Check lubricant level

KNOWLEDGE/THEORY:

1. Operation of transfer case
2. Techniques of securing vehicle
    a. Brakes
    b. Wheel chocks
    c. Jack stands
3. Operation of u-joints and slip splines
4. Safe use of lifting equipment
5. Lubrication techniques
    a. U-joints and splines
    b. Gear oil level
    c. Type of gear oil

VALUE/ATTITUDE CONCEPTS: See general list on Page 11.

TASK AREA: Power Trains

TASK #150: Rebuilds transfer case.

COMPETENCY: Rebuild transfer case by replacing worn parts to assure that transmission shifts properly, remains engaged and has no oil leaks or noises.

CRITERION: Can properly disassemble transfer case.

Can properly clean and prepare surfaces for inspection.

Can visually and with proper instruments determine condition of case and parts for reuse.

Can properly select needed parts and reassemble transfer case to assure proper engagement, smooth shifting, minimum noise and no oil leaks.

SKILL/PROCESS:

1. Disassemble transfer case
2. Clean parts and prepare machined surfaces for inspection
3. Inspect parts visually and with measuring instruments
4. Make decision on reuse of parts
5. Select replacement parts
6. Reassemble transfer case being sure to maintain clearances to manufacturer's specifications
7. Check for proper shifting

KNOWLEDGE/THEORY:

1. Operation of transfer case
   a. Principles of unsynchronized gearing
   b. Principles of constant mesh gearing
2. Use of shop tools
   a. Hydraulic and arbor presses
   b. Gear pullers
3. Cleaning techniques
   a. Hot tank
   b. Wet tank
   c. Solvent and brush
   d. Glass bead blasting
4. Mechanical checks
   a. Visual inspection
   b. Micrometer or caliper checks
   c. Housing damage
   d. Straightness of rods and shafts
5. Reassembly techniques
   a. Proper clearances between gears
   b. Lubrication techniques

VALUE/ATTITUDE CONCEPTS: See general list on Page 11.

NOT INCLUDED IN THE
DIESEL VEHICLE MAINTENANCE
CURRICULUM

TASK AREA: Heavy Equipment

TASK #151: Rebuilds final drive for off-road machine.

NOT INCLUDED IN THE
DIESEL VEHICLE MAINTENANCE
CURRICULUM

TASK AREA: Heavy Equipment

TASK #152: Overhauls steering clutches.

TASK AREA: Power Trains

TASK #153: Removes and reinstalls power takeoff unit.

COMPETENCY: Remove and reinstall power takeoff unit adjusting to manufacturer's specifications to insure correct tooth engagement, shift mechanism operation, and no oil leaks.

CRITERION: Can properly remove power takeoff unit.

Can clean and visually inspect mounting surface to determine if repair is necessary.

Can properly install power takeoff unit using recommended gaskets and/or sealant to assure correct tooth depth and no oil leaks.

Can properly adjust shift mechanism to assure proper engagement.

SKILL/PROCESS:

1. Remove power takeoff
2. Clean and inspect mounting surface
3. Install power takeoff
4. Using gaskets and sealant assure correct tooth depth
5. Adjust shift mechanism for proper engagement
6. Check for oil leaks

KNOWLEDGE/THEORY:

1. Operation of transmission
2. Operation of power takeoff
    a. Single speed
    b. Reversible units
    c. Dual output shaft units
    d. Top mount unit for auxiliary transmission
3. Removal (drain transmission for 6 and 8 bolt models)
4. Installation techniques
    a. Gear backlash
    b. Gear clatter or whine while operating
    c. Phasing of u-joints
    d. Adjustment of shift mechanism
    e. Lubrication

VALUE/ATTITUDE CONCEPTS: Awareness of special need to follow procedure.

TASK AREA: Power Trains

TASK #154: Rebuilds power takeoff.

COMPETENCY: Rebuild power takeoff by replacing worn parts to assure power takeoff shifts properly and has no oil leaks.

CRITERION: Can properly disassemble power takeoff unit.

Can clean unit properly.

Can visually and with proper instruments determine wear or damaged parts.

Can select proper replacement parts and correctly assemble unit to manufacturer's specification to shift properly and assure no oil leaks.

SKILL/PROCESS:

1. Disassemble power takeoff.
2. Clean power takeoff.
3. Inspect visually and measure parts to determine wear
4. Select replacement parts.
5. Assemble power takeoff according to manufacturer's specifications
6. Check unit for proper shifting

KNOWLEDGE/THEORY:

1. Operation of transmission
2. Operation of power takeoff
    a. Single speed
    b. Reversible units
    c. Dual output shaft units
    d. Top mount unit for auxiliary transmission
3. Cleaning techniques
    a. Hot tank
    b. Cold tank
    c. Solvent and brush
    d. Glass bead blasting
4. Mechanical checks
    a. Visual inspection
    b. Micrometer or caliper checks
    c. Housing damage
    d. Straightness of shafts
5. Reassembly techniques
    a. Correct adjustment of shaft bearings
    b. Correct movement of sliding gears and shifting mechanism
    c. Lubrication techniques

VALUE/ATTITUDE CONCEPTS: Awareness of special need to follow procedure.

TASK AREA: Diesel Fuel Systems

TASK #155: Rebuilds and calibrates fuel injection pumps.

COMPETENCY: Rebuild and calibrate fuel injection pumps to manufacturer's specifications.

CRITERION:

Can disassemble pump following manufacturer's procedures to prevent damage and contamination of fitted and mated parts.

Can clean parts using correct cleaning agent.

Can visually and with instruments determine condition of parts for reuse.

Can select needed parts and reassemble pump following manufacturer's recommendations to assure pump can be calibrated to specified limits and proper condition.

Can install pump on calibration machine.

Can select calibration specification for pump and engine application.

Can properly perform needed calibration to adjust to manufacturer's specifications.

SKILL/PROCESS:

1. Select calibration specifications for pump and engine application
2. Mount pump on calibration machine
3. Run pump on calibration machine to determine condition of pump. Document pump condition
4. Disassemble pump following repair manual procedures
5. Clean all parts with specified cleaning agents as directed in repair manual
6. Inspect parts visually for serviceable condition
7. Measure parts with precision tools as required to determine wear condition
8. Discard all defective parts
9. Select required new or reconditioned parts
10. Reassemble pump following repair manual procedures
11. Install pump on calibration machine following procedures
12. Calibrate pump according to specifications for specific engine
13. Remove pump from calibration machine and tag pump as to engine application

KNOWLEDGE/THEORY:

1. Function of fuel injection pump
    a. Deliver fuel to injector system
    b. Meter fuel flow
    c. Provide pressure

2. Types of fuel injection pumps
    a. Pressure-time
    b. High pressure multiple plunger
    c. Distributor
    d. Unit injector
3. Pump components
    a. Internal
        (1) Governor
        (2) Drive
        (3) Plungers
        (4) Barrel assemblies
        (5) Delivery valve assemblies
        (6) Racks
        (7) Timing advance unit
    b. External
        (1) Check valves
        (2) Supply pumps
        (3) Pulsation damper
        (4) Timing advance unit
4. Techniques of disassembly
    a. Cleaning
    b. Step-by-step process
    c. Protection of parts
        (1) Lubrication
        (2) Matched units
        (3) Corrosion
5. Rebuilding techniques
    a. Protection of parts
    b. Inspecting with visual aids
    c. Measuring
    d. Reconditioning parts
        (1) Lapping
        (2) Polishing
    e. Replacing parts
    f. Lubrication
    g. Assembly marking and alignment
    h. Torquing
6. Test equipment and function
    a. Flow meters
    b. Pressure gauges
    c. Comparator
    d. Pump test stands
7. Calibration and testing
    a. Temperature
    b. Phasing
    c. Quantity flow (cc)
    d. Pressure
    e. Governor adjustments - rpm
    f. Advance mechanisms
    g. Protection of orifices

VALUE/ATTITUDE CONCEPTS: Awareness for need for cleanliness, following exact procedure, specifications, and torquing.

TASK AREA: Diesel Fuel Systems

TASK #156: Rebuilds fuel supply pump.

COMPETENCY: Rebuild and test fuel supply pump to manufacturer's specifications.

CRITERION: Can properly disassemble and clean supply pump preventing damage to machined surfaces.

Can visually and with instruments determine condition of parts for reuse.

Can select needed replacement parts and reassemble supply pump following manufacturer's practices.

Can properly mount supply pump to test bench and perform tests to determine if pump meets manufacturer's suction, pressure, and volume specifications.

SKILL/PROCESS:

1. Properly disassemble and clean supply pump taking care to prevent damage to machined surfaces
2. Visually inspect and measure tolerances with correct instruments to determine if parts are within specification for reuse.
3. Select correct replacement parts and reassemble supply pump following specified manual procedures
4. Mount supply pump to test bench according to manual procedures and perform test to determine if pump meets manufacturer's specifications for suction, pressure, and volume limits

KNOWLEDGE/THEORY:

1. Function of fuel supply (transfer) pump
2. Types of fuel supply (transfer) pumps
    a. Gear type
    b. Vane type
    c. Piston type
    d. Diaphragm type
3. Disassembly techniques
    a. Cleanliness
    b. Safeguard ground surfaces from damage
    c. Cleaning techniques
    d. Inspection of parts for reuse
4. Reassembly techniques
    a. Cleanliness
    b. Lubrication of parts
    c. Torquing of fasteners
5. Testing
    a. Rate of flow
    b. Pressure
    c. Internal leaks

VALUE/ATTITUDE CONCEPTS: Awareness for need for cleanliness, following exact procedure, specifications, and torquing.

TASK AREA: Diesel Fuel Systems

TASK #157: Inspects, cleans, and lubricates fuel pump subassembly.

Listed with Task #201

TASK AREA: Diesel Fuel Systems

TASK #158: Rebuilds and tests governor.

COMPETENCY: Rebuild, test, and adjust governor to manufacturer's specifications using test stand, if applicable.

CRITERION: Can properly disassemble and clean governor parts following manufacturer's recommendations.

Can visually and with proper instruments determine condition of parts and make decisions for reuse.

Can properly select needed parts and reassemble following manufacturer's recommended sequence.

Can properly mount governor to test equipment (where applicable) and adjust to manufacturer's specifications for make and engine application.

SKILL/PROCESS:

1. Disassemble and clean governor parts following manufacturer's recommendations
2. Make visual inspection and measure parts
3. Determine if parts are reusable
4. Select required parts and reassemble governor following repair manual procedure
5. Mount governor to test equipment following manual sequence (where applicable) and adjust to specification

KNOWLEDGE/THEORY:

1. Function of governor
    a. Control rpm of engine
    b. Control fuel flow to engine
2. Type of governor
    a. Mechanical
    b. Hydraulic
    c. Variable speed
    d. Constant speed
3. Rebuilding techniques
    a. Disassembly procedures
        (1) Cleanliness
        (2) Protection of parts
        (3) Inspection of components
    b. Reassembly procedures
        (1) Parts
        (2) Lubrication of components
        (3) Fittings to specifications
        (4) Adjustments and torquing
4. Testing and adjusting
    a. Free movement test
    b. Equipment test
    c. On vehicle test
    d. Methods of adjustment

VALUE/ATTITUDE CONCEPTS: Awareness for need for cleanliness, following exact procedure, specifications, and torquing.

TASK AREA: Diesel Fuel Systems

TASK #158A: Tests and adjusts governor on engine in vehicle.

COMPETENCY: Test and adjust governor on engine in vehicle so engine operates within high and low rpm specified by factory specifications or customer.

CRITERION: Can properly secure vehicle for test purposes.

Can properly prepare access to governor by removing access panels and/or raising cab.

Can properly start and warm up engine prior to governor test.

Can select proper specifications for governor and engine application.

Can properly perform test and make necessary adjustment to assure high & low rpm's are within specifications.

Can properly replace access panels and/or lower and secure cab to make vehicle "road ready."

SKILL/PROCESS:

1. Properly secure vehicle for test purposes following repair manual procedures
2. Remove access panels or raise cab as required following repair manual procedures
3. Start and warm engine to required temperature prior to testing governor
4. Select specification for governor and engine application in manual
5. Run engine and make necessary adjustments for high and low rpm's as specified in repair manual
6. Replace access panels or lower cab whichever is applicable and ready vehicle for road

KNOWLEDGE/THEORY:

1. Function of governors
2. Principles of governors
    a. Mechanical
        (1) Bosch
        (2) Cummins
        (3) Detroit Dsl.
    b. Hydraulic
3. Techniques of governor adjustment
    a. Engine stabilization
    b. Governor specifications
    c. Governor application
4. Function of test equipment
    a. Tachometer
    b. Special tools
5. Techniques of vehicle securing
    a. Transmission
    b. Brakes
    c. Cab jacks and safety latches
    d. Wheel chocks

VALUE/ATTITUDE CONCEPTS: Awareness for need for cleanliness, following exact procedure, specifications, and torquing.

TASK AREA: Diesel Fuel Systems

TASK #159: Rebuilds and tests air fuel ratio valves.

COMPETENCY: Rebuild and test air fuel ratio valves to manufacturer's specifications.

CRITERION: Can properly disassemble and clean air/fuel ratio valve.

Can visually and with instruments determine condition of parts for reuse.

Can select replacement parts and reassemble following recommended procedures.

Can select test and adjustment specifications for air/fuel ratio, valves, and engine applications.

Can properly adjust air/fuel ratio valve to perform to manufacturer's specifications.

SKILL/PROCESS:

1. Disassemble and clean air/fuel ratio valve using approved cleaning agent
2. Inspect visually and measure parts to determine if they are within specification for reuse
3. Select required replacement parts and reassemble following manual procedures
4. Select test and adjustment specifications for air/fuel ratio valve according to engine application
5. Follow manual procedures and adjust air/fuel ratio valve to specifications

KNOWLEDGE/THEORY:

1. Function of fuel air ratio valves
2. Principles of fuel air ratio valves
    a. Aneroid-external
    b. Aneroid-internal
    c. Throttle-delay mechanism
3. Techniques of valve repair
    a. Disassembly
    b. Cleaning
    c. Inspection
    d. Reassembly
4. Methods of adjustment of air ratio valves
    a. Pressure flow
    b. Time delay

VALUE/ATTITUDE CONCEPTS: Awareness for need for cleanliness, following exact procedure, specifications, and torquing.

DO NOT FILM

TASK AREA: Diesel Fuel Systems

TASK #160: Tests fuel injectors and nozzles.

COMPETENCY: Test fuel injectors and nozzles using correct test equipment to determine if injectors or nozzles show evidence of internal or external leakage, proper spray pattern, proper atomization, and nozzle "popping" pressure within specifications.

CRITERION: Can select test equipment and mount injectors or nozzles for testing.

Can select proper test specifications for unit being tested.

Can properly perform tests following manufacturer's specifications for injectors or nozzles and/or following manufacturer's procedures for testing equipment.

Can properly identify visual spray pattern, atomization, and/or sounds of nozzles and injectors.

SKILL/PROCESS:

1. Select test equipment and mount injector or nozzle for testing following manual procedures
2. Select test specifications for unit to be tested
3. Test injector or nozzle and determine if it is within specification
4. Check spray pattern and atomization visually and listen for sounds and determine if they meet specifications

KNOWLEDGE/THEORY:

1. Function
    a. Injectors
        Atomization of fuel
            (a) Determines rate of flow
            (b) Directs flow of fuel
    b. Nozzle
        (1) Directs fuel into combustion chamber
        (2) Determines pattern of fuel
        (3) Atomizes fuel
2. Types of injectors
    a. Unit (needle valve and crown)
    b. Pencil
3. Types of nozzles
    a. Multihole
    b. Pintle (conical)
    c. Pintle (cylindrical)
    d. Pintaux
4. Testing prior to rebuilding
    a. Specifications of proper unit being tested
    b. Proper test equipment
    c. Pop off pressure
    d. Spray pattern
    e. Atomization
    f. Leakage
    g. Determine if injector and nozzle meet specifications

VALUE/ATTITUDE CONCEPTS:	Awareness for need for cleanliness, following exact procedure, specifications, and torquing. Awareness of safety when working with high pressure.

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TASK AREA: Diesel Fuel Systems

TASK #161: Rebuilds and tests fuel injector and nozzles.

COMPETENCY: Rebuild, test, adjust, and/or calibrate to manufacturer's specifications.

CRITERION: Can properly disassemble unit following recommended procedures to assure "mated" parts are kept together, highly fitted parts are not damaged by handling or disassembly, and internal parts are not contaminated.

Can clean parts using correct cleaning procedure and agents.

Can visually and with proper instruments determine condition of parts for reuse.

Can select replacement parts.

Can lap surfaces as needed to assure proper sealing.

Can properly assemble unit following manufacturer's recommended procedures.

Can select proper test equipment needed to test, adjust, or calibrate unit.

Can test, adjust, or calibrate to manufacturer's specifications.

SKILL/PROCESS:

1. Disassemble unit while assuring that "mated" parts are kept together and precision ground surfaces are not damaged
2. Clean all parts using cleaning agent specified in manual
3. Make visual inspection and measure parts to determine their condition for reuse
4. Lap surfaces to manufacturer's specifications
5. Select required replacement parts
6. Assemble unit following manual procedures
7. Select appropriate test equipment for unit to be tested
8. Mount unit to tester, test, and calibrate unit to manual specifications

KNOWLEDGE/THEORY:

1. Function
    a. Injectors
        Atomization of fuel
        (a) Determines rate of flow
        (b) Directs flow of fuel
    b. Nozzle
        (1) Directs fuel into combustion chamber
        (2) Determines pattern of fuel
        (3) Atomizes fuel
2. Types of injectors
    a. Unit (needle valve and crown)
    b. Pencil

3. Types of nozzles
    a. Multihole
    b. Pintle (conical)
    c. Pintle (cylindrical)
    d. Pintaux
4. Testing prior to rebuilding
    a. Specifications of proper unit being worked
    b. Proper test equipment
    c. Pop off pressure
    d. Spray pattern
    e. Atomization
    f. Leakage
    g. Determine if injector and nozzle meet specifications
5. Cleanliness
    a. Cleaning materials
        Fuel oil
    b. Protection of parts
6. Parts mating and disassembly
    a. Matching of parts
    b. Disassembly procedure
7. Parts inspection
    a. Lapping parts
    b. Measuring parts
8. Reassembly
    a. Procedure
    b. Lubrication
    c. Torque and specifications
9. Testing after rebuilding
    a. Leakage
    b. Spray pattern
    c. Freeness
    d. Calibration

VALUE/ATTITUDE CONCEPTS: Awareness for need for cleanliness, following exact procedure, specifications, and torquing.

TASK AREA: Engines

TASK #162: Disassembles engine, cleans components to make parts ready for inspection.

COMPETENCY: Disassemble engines using correct procedures and materials and clean and protect all parts from damage so parts are ready for inspection.

CRITERION: Can disassemble engine using recommended practices and procedure to assure proper identification and location of parts and no contamination or damage to fuel system.

Can select appropriate cleaning method for the various components.

SKILL/PROCESS:

1. Mount engine in work stand as appropriate
2. Secure engine to work on a clean place on the floor as appropriate
3. Disassemble major components of engine
4. Disassemble components into small parts
5. Clean ferrous metal parts in hot tank
6. Clean aluminum parts in solvent or cold tank cleaner
7. Lay out parts in a clean work area and/or on workbenches for inspection

KNOWLEDGE/THEORY:

1. Use of tools
   a. Hand tools
   b. Air wrench
   c. Hydraulic press
   d. Pullers
2. Prevention of contamination
   a. Fuel lines open
   b. Oil line open
   c. Air lines open
3. Technique and materials for cleaning
   a. Steam cleaning
   b. Ferrous metals
      Hot tank and glass bead blasting
   c. Aluminum metals - cold tank
4. Principles of engine disassembly
   a. Basic engine construction
   b. Use of service manuals
   c. Proper components sequence
5. Organize parts for inspection
   a. External parts
   b. Internal parts

VALUE/ATTITUDE CONCEPTS: Awareness of extra need to follow precautions in handling parts so as not to damage.

Awareness of chemical effects on parts.

TASK AREA: Diesel Engines

TASK #163: Inspects block bores and surfaces and makes decision on repairs.

COMPETENCY: Inspect block bores and surfaces using visual inspection, measuring, and testing equipment to determine if block conforms to manufacturer's specifications and make recommendations on repair.

CRITERION: Can visually inspect block for damage and make recommendation for further testing or discarding of block.

Can properly use magnetic or dye penetrant test to determine if block is cracked and make decision on further testing or discarding of block.

Can select proper test equipment to determine if block bores are within specification and make recommendation for repairs and/or reconditioning or discarding.

SKILL/PROCESS:

1. Visually inspect block for cracks, stripped threads, and other damage
2. Use magnetic particle test or dye penetrant test to check areas for hidden cracks
3. Use appropriate micrometer or dial bore gauge to check cylinder bores for taper and out-of-roundness
4. Use straight edge and feeler gauge to check block surface for flatness

KNOWLEDGE/THEORY:

1. Purpose of inspection
    a. Identify damage
    b. Identify wear
2. Methods of inspecting block bore and surfaces
    a. Visual inspections
        (1) Cracks
        (2) Stripped threads
        (3) Surface damage
    b. Measurement list
        (1) Surface flatness
        (2) Bore diameter
    c. Magnetic particle test
        (1) Purpose of magnetic test
            Locates cracks without damage
        (2) Principles of magnetic test
            (a) Magnetism
            (b) Metal particles
            (c) Fluorescent
        (3) Method of conducting test
            (a) Secure magnet to block
            (b) Apply metal particles
    d. Dye penetrant test
        (1) Purpose of dye penetrant
            To confirm a suspected crack

    - (2) Principle of dye
        - Absorption of dye in cracks
    - (3) Method of conducting test
        - (a) Preliminary identification of crack area
        - (b) Cover suspected crack area with dye
- e. Pressure test
    - (1) Purpose of pressure test
    - (2) Methods of pressure test
        - (a) Water
        - (b) Fluorescing agent
        - (c) Lights

VALUE/ATTITUDE CONCEPTS: Awareness of need of accuracy in precision measuring.

TASK AREA: Diesel Engines

TASK #164: Repairs block bores and surfaces.

COMPETENCY: Repair block by determining correct reconditioning procedure and performing procedure to return block to manufacturer's specifications.

CRITERION: Can select appropriate reconditioning technique as applicable to the necessary repair.

Can select proper specification for engine block.

Can perform reconditioning technique following equipment manufacturer's recommended procedure to insure block bores and surfaces conform to engine manufacturer's specifications.

SKILL/PROCESS:

1. Select specifications for make and model of engine block
2. Select reconditioning technique and set up equipment for line boring, cylinder boring, surface milling, thread repair, welding, or any other repair
3. Perform machine work on block

KNOWLEDGE/THEORY:

1. Types of block repairs
   a. Surfaces milling
   b. Cylinder boring
   c. Cam boring
   d. Crank boring
   e. Deburr lifter boring
   f. Threaded holes reconditioning
2. Techniques of reconditioning
   a. Manufacturers' specifications
   b. Safety of equipment set up
   c. Boring bar operation
   d. Cylinder housing operation
   e. Cam bearing replacement
   f. Crankshaft reconditioning
   g. Welding procedure
      (1) Electrical welding
      (2) Brass welding

VALUE/ATTITUDE CONCEPTS: See general list on Page 11.

TASK AREA: Diesel Engines

TASK #165: Inspects block machine work and installs cam bearings, core and gallery plugs.

COMPETENCY: Inspect block machine work using measuring instruments to determine if block machining is within specifications and install cam bearings correctly and core and gallery plugs to prevent leaks.

CRITERION: Can select proper specification as related to engine block.

Can select proper test equipment and determine if reconditioned block is within manufacturer's specification.

Can select proper cam bearings, core, and gallery plugs.

Can properly install cam bearing so all oil holes are open and bearings allow for free movement of cam shaft.

Can properly install core and gallery plugs so they are secure and free of leaks.

SKILL/PROCESS:

1. Select specifications for make and model of engine block
2. Use measuring instruments to determine if block machine work meets manufacturer's specifications
3. Install cam bearings
4. Install core and gallery plugs

KNOWLEDGE/THEORY:

1. Technique of measuring machine work
   a. Select specification for model block
   b. Use of measuring instrument
   c. Manufacturer's specification
2. Principles of installing block components
   a. Proper tools
   b. Sealing compounds
   c. O-rings replacement
   d. Gallery plugs and cores
   e. Free movement of components
   f. Free of leaks
   g. Cam bearings
      (1) Oil hole alignment
      (2) Proper fit of cam shaft

VALUE/ATTITUDE CONCEPTS: Awareness of proper alignment of all orifices.

TASK AREA: Diesel Engines

TASK #166: Inspects cylinder liner and makes decision on reuse.

COMPETENCY: Inspect cylinder liner by visual means, test equipment and measuring instruments to determine if liner is within specifications and can be reused.

CRITERION: Can visually inspect liners for damage and recommend further testing or discarding.

Can select the specification for the particular liner and engine application.

Can select appropriate test equipment and inspect liner for concealed defects.

Can select proper measuring instruments to determine if liner is serviceable.

SKILL/PROCESS:

1. Visually inspect liner
2. Select specifications for make and model of engine
3. Use magnetic particle test or dye penetrant test to inspect for hidden cracks
4. Use measuring instruments to check taper, out-of-roundness, outside diameter, and flange thickness

KNOWLEDGE/THEORY:

1. Types of liners
    a. Wet
    b. Dry
2. Technique of measuring liner
    a. Cleaning
    b. Taper
    c. Out-of-roundness
    d. Outside diameter
    e. Flange thickness
3. Liner inspection for reuse
    a. Visually inspect
    b. Magnetic particle
    c. Dye penetrant
    d. Hidden cracks

VALUE/ATTITUDE CONCEPTS: See general list on Page 11.

TASK AREA: Diesel Engines

TASK #167: Reconditions cylinder liner by boring and/or honing.

COMPETENCY: Recondition cylinder liner by boring and/or honing to manufacturer's specifications.

CRITERION: Can select test equipment to determine if boring and/or honing is required.

Can properly prepare block for boring and bore cylinder as recommended by equipment manufacturer.

Can hone cylinder liner bores to manufacturer's specifications as to finish, taper, and out-of-roundness.

SKILL/PROCESS:

1. Measure liner bore to determine if honing or boring is required
2. Set up machine and bore block to appropriate oversize
3. "Finish hone" hole after boring
4. Inspect and measure hole for correct cross-batch pattern and taper and out-of-round limits

KNOWLEDGE/THEORY:

1. Purpose of liner
   a. Cylinder wall
   b. Removable liners
   c. Water jacket for heat exchange
   d. Economics of repair
2. Techniques of reconditioning liners
   a. Select manufacturer's specifications
   b. Boring
   c. Honing
3. Techniques of reconditioning cylinder liners
   a. Boring methods
   b. Honing bore to a finish
   c. Measuring hole for correct size

VALUE/ATTITUDE CONCEPTS: See general list on Page 11.

TASK AREA: Diesel Engines

TASK #168: Inspects pistons and makes decision on reuse.

COMPETENCY: Inspect pistons by measuring and comparing measurements to manufacturer's specifications and checking for visual damage to determine if piston can be reused.

CRITERION: Can select proper specification for piston and application.

Can visually inspect piston for damage to determine if serviceable.

Can select proper measuring and test equipment to determine if piston is serviceable.

SKILL/PROCESS:

1. Select specifications for make and model of engine
2. Visually inspect pistons
3. Measure piston dimensions and check with dye penetrant if appropriate

KNOWLEDGE/THEORY:

1. Purpose of piston
    a. Transmits force of combustion
    b. Forms portion of cylinder chamber
    c. Sets up turbulence
    d. Compresses air
2. Construction of piston
    a. Shape
    b. Crown
    c. Land and grooves
    d. Wrist pin
    e. Surface finishes
3. Piston inspection for reuse
    a. Manufacturer's specifications
    b. Cleaning methods
    c. Visual inspection
4. Techniques in measuring piston
    a. Measuring tools
    b. Land width
    c. Ring groove depth
    d. Pin bore
    e. Piston skirt
    f. Piston dimension

VALUE/ATTITUDE CONCEPTS: See general list on Page 11.

TASK AREA: Diesel Engines

TASK #169: Repairs piston skirts, ring grooves, and pin bores.

COMPETENCY: Using appropriate machining process, bring the piston to dimensions within specifications.

CRITERION: Can select proper specification for piston and engine application.

Can select proper equipment and resize piston skirt following manufacturer's recommendation.

Can select proper equipment to recondition ring grooves following manufacturer's recommendations.

Can select proper equipment to recondition or resize pin bores following manufacturer's recommendations.

SKILL/PROCESS:

1. Select specifications for make and model of engine
2. Measure piston skirts and resize as appropriate
3. Measure ring grooves and resize for steel ring groove insert
4. Measure wrist pin bores and resize for oversize wrist pin

KNOWLEDGE/THEORY:

Purpose and Function

1. Piston skirt - lower part of piston
    a. Support
    b. Prevent slap
    c. Repairing
        (1) Knurling
        (2) Pinging
2. Ring grooves
    a. Recess cut around piston
        (1) Oil ring groove cuts
        (2) Compression ring groove cuts
    b. Purpose to hold rings
    c. Number varies on type piston
    d. Repairing - resizing
3. Pin bores
    a. Purpose - to hold piston pin
    b. Types of pins
        (1) Floating
        (2) Semi-floating
    c. Repairing
        (1) Resizing
        (2) Replacing

VALUE/ATTITUDE CONCEPTS: See general list on Page 11.

TASK AREA: Diesel Engines

TASK #170: Inspects connecting rods and makes decision on reuse.

COMPETENCY: Visually inspect for damage, check dimensions using proper measuring methods and test equipment to determine if rod meets manufacturer's specifications.

CRITERION: Can visually inspect connecting rod for damage and determine if serviceable.

Can select proper specification for rod.

Can select proper measuring instruments following manufacturer's recommendations to determine if rod bores, center-to-center distance, twist, and bend are within specifications.

Can select testing equipment and determine whether rod has physical defects or damage.

SKILL/PROCESS:

1. Select specifications for make and model of engine
2. Visually inspect rod
3. Use appropriate fixture and check bend and twist of rod and center-to-center distance of crank and wrist pin bores
4. Measure diameter and out-of-roundness of bores

KNOWLEDGE/THEORY:

1. Function of connecting rod
2. Component parts of connecting rod
    a. Rod bolts
    b. Pin bushings
    c. Rod forging
    d. Crank bearing bore
3. Methods of rod inspection
    a. Visual
    b. Magnetic
    c. Measurements
        (1) Alignment tester
        (2) Micrometers
        (3) Dial bore gauges
        (4) Telescoping gauge
4. Techniques of rod inspection
    a. Visual damage
    b. Magnetic inspection
    c. Rod alignment tester
        (1) Twist
        (2) Bend
        (3) Center-to-center
    d. Bore inspection
        (1) Out-of-roundness
        (2) Oversize or undersize
        (3) Surface finish

VALUE/ATTITUDE CONCEPTS: See general list on Page 11.

TASK AREA: Diesel Engines

TASK #171: Reconditions connecting rod bores, repairs slight bends and twists.

COMPETENCY: Recondition bores, correct twists and bends, and maintain center-to-center distance to within manufacturer's specifications.

CRITERION: Can select proper specification for connecting rod.

Can select proper reconditioning technique to restore connecting rod bores to specifications following manufacturer's recommendations.

Can select proper technique to bring twist and bend to within manufacturer's tolerances.

SKILL/PROCESS:

1. Select specifications for make and model of engine
2. Repair slight bend or twist to manufacturer's specifications
3. Resize rod bores as appropriate and install new wrist pin bushings

KNOWLEDGE/THEORY:

1. Purpose of connecting rods
   a. Transmits power between piston and crankshaft
   b. Provides bearing holder
2. Types of connecting rods
   a. Offset type
   b. Drilled and non-drilled
3. Methods of reconditioning rods
   a. Correct twists
   b. Correct bend
   c. Pin bore resize
   d. Rod bore resize

VALUE/ATTITUDE CONCEPTS: See general list on Page 11.

TASK AREA: Diesel Engines

TASK #172: Inspects crankshaft for cracks, wear, and straightness, and makes decision for reconditioning work.

COMPETENCY: Inspect crankshaft for cracks, wear, and straightness by visual inspection and with measuring instruments and testing equipment. Determine whether crankshaft is within manufacturer's specifications and make decision on reconditioning.

CRITERION: Can visually inspect crankshaft for damage and serviceability.

Can select specification for crankshaft.

Can select proper test and measuring instruments to determine if crankshaft is within specification and make decision as to need for machine work or discarding.

SKILL/PROCESS:

1. Select specifications for make and model of engine
2. Visually inspect crankshaft
3. Measure bearing journals with micrometer
4. Measure journal fillets with radius gauge
5. Check crankshaft for run-out with dial indicator
6. Check for hidden cracks with magnetic particle method or dye penetrant

KNOWLEDGE/THEORY:

1. Purpose of crankshaft
    a. Change reciprocating motion to rotor motion
    b. Drive subassembly
    c. Transmits force to other assembly
2. Crankshaft parts and functions
    a. Main bearing journals
    b. Throws (counterweights)
    c. Rod bearing journals
    d. Flange
    e. Oil galleries
    f. Oil seal journal
    g. Gallery plugs
    h. Counterweights
    i. Nose
3. Crankshaft types
    a. V-type
    b. Inline
    c. Radial
4. Crankshaft design
    a. Balance
    b. Surface treatment
    c. Fillets
5. Methods of inspecting crankshaft
    a. Cracks

    - (1) Visually
    - (2) Dye penetrant
    - (3) Magnetic particles
- b. Wear
    - (1) Radius gauge
    - (2) Micrometer
- c. Straightness and run-out
    - (1) V-block
    - (2) Lathe
    - (3) Dial indicator

VALUE/ATTITUDE CONCEPTS: See general list on Page 11.

TASK AREA: Diesel Engines

TASK #173: Inspects machine work on reconditioned crankshaft.

COMPETENCY: Inspect machine work on reconditioned crankshaft to verify that dimensions are within manufacturer's specifications.

CRITERION: Can select proper specification for crankshaft.

Can select proper test and measuring instrument to determine if machine work has brought crankshaft back within manufacturer's specifications.

SKILL/PROCESS:

1. Select specifications for make and model of engine
2. Measure bearing journals with micrometer
3. Check fillets with radius gauge
4. Measure run-out with dial indicator

KNOWLEDGE/THEORY:

1. Method of inspecting machine work on crankshaft
   a. Manufacturer's specification
   b. Main bearings - micrometer
   c. Rod bearings - micrometer
   d. Fillets - radius gauge
   e. Run-out - dial indicator
2. Effects of specifications tolerances
   a. Oil pressure
   b. Lubrication

VALUE/ATTITUDE CONCEPTS: See general list on Page 11.

TASK AREA: Diesel Engines

TASK #174: Installs bearings, crankshaft, piston coolers, liners, rings, pistons and rods, fitting all components to manufacturer's specifications.

COMPETENCY: Install bearings, crankshaft, piston coolers, liners rings, pistons, and rods according to manufacturer's recommended procedures using checks to assure all components are installed within manufacturer's tolerances and specifications.

CRITERION: Can select proper specification for engine components and application.

Can properly install main bearings and crankshaft in block using recommended procedures to insure proper clearances, end play, and lubrication of bearings.

Can properly install piston coolers to insure oil spray pattern is directed as per specifications and no external oil leaks.

Can properly install liners following recommended procedures to insure proper liner height, bore diameters, and sealing of coolant.

Can properly install piston pins and locks, install rings to piston and assemble with bearing to crankshaft following recommended procedures to assure proper bearing and rod clearances, rod-piston-pin articulation, and ring functioning.

SKILL/PROCESS:

1. Select specifications for make and model of engine
2. Install main bearings, thrust washers, and crankshaft
3. Check end play
4. Install and adjust piston oil cooling nozzles
5. Install wet or dry liners and check for correct protrusion
6. Install pistons on connecting rods being sure to center press fit types
7. Install wrist pin locks if appropriate
8. Install rings on pistons
9. Install pistons and rods in engine
10. Check connecting rod end play

KNOWLEDGE/THEORY:

1. Function of parts
    a. Bearings
    b. Crankshaft
    c. Piston coolers
    d. Liners

        - e. Rings
        - f. Pistons
        - g. Rods
    - 2. Installation procedures
        - a. Cleanliness
        - b. Identification of parts and relationship to mating parts
    - 3. Techniques of assembly
        - a. Order of parts assembly
        - b. Tightening and torquing methods
        - c. Seals
        - d. Locking devices

VALUE/ATTITUDE CONCEPTS: Awareness of exacting installation procedures to assure proper installation and torquing.

TASK AREA: Diesel Engines

TASK #175: Makes in-frame inspection of bearing wear and installs new bearings.

COMPETENCY: Make in-frame inspection for bearing wear using visual inspection and measuring instruments to make decision on reuse and/or install new bearings to comply with manufacturer's specifications.

CRITERION: Can visually inspect bearings and determine need for replacement or further measurement.

Can select specification for bearing and engine application.

Can select measuring instrument to determine if bearings are serviceable or need to be discarded.

Can properly select replacement parts and install bearings following manufacturer's procedures to assure proper clearances and lubrication of bearings.

SKILL/PROCESS:

1. Select specifications for make and model of engine
2. Visually inspect bearings
3. Measure crankshaft and bearings with micrometers
4. Select correct replacement bearings
5. Install bearings and torque bolts

KNOWLEDGE/THEORY:

1. Reasons for in-frame repair
   a. Restore oil pressure
   b. Economics of repair
2. Methods of inspecting
   a. Shim stock
   b. Triangulation gauge
   c. Plastic gauge (lead wire)

VALUE/ATTITUDE CONCEPTS: Awareness of exacting installation procedures to assure proper installation and torquing.

TASK AREA: Diesel Engines

TASK #176: Removes, inspects, and installs balancer shafts.

COMPETENCY: Visually and with measuring instruments determine whether balancer shaft is serviceable or can be repaired.

CRITERION: Can visually recognize damage to shaft which precludes reuse.

Can select measuring instruments and test to determine if bearing surfaces are within manufacturer's specifications.

Can measure to determine if shaft run-out is within manufacturer's specifications.

SKILL/PROCESS:

1. Remove balancer shaft from engine
2. Select specifications for make and model of engine
3. Visually inspect shaft for physical damage
4. Remove counter weights if appropriate
5. Measure bearing journals with micrometer
6. Measure run-out with dial indicator
7. Check splines, keys, or other alignment aids for removable counter weights
8. Install counter weights and gears
9. Install balance shafts in engine

KNOWLEDGE/THEORY:

1. Purpose of balancer shaft
2. Parts
   a. Shaft
   b. Counterweights
   c. Gears
3. Installation
   a. Timing
   b. Weight position

VALUE/ATTITUDE CONCEPTS: Awareness of exacting installation procedures to assure proper installation and torquing.

TASK AREA: Diesel Engines

TASK #176A: Removes, inspects, and installs vibration dampers.

COMPETENCY: Remove and inspect visually and with measuring instruments to determine if damper meets manufacturer's specifications for reuse.

CRITERION: Can visually recognize damage to vibration damper which precludes reuse.

Can select measuring instruments and test to determine if radial and lateral run-out meet manufacturer's specifications.

SKILL/PROCESS:

1. Remove damper without damaging unit
2. Visually inspect viscous damper for dents, cracks, damaged bolt holes, or other damage
3. Visually inspect elastic damper for displaced rubber element, cracks, damaged bolt holes, or outer inertia ring that has slipped out of alignment with hub
4. Check radial and lateral run-out with dial indicator

KNOWLEDGE/THEORY:

1. Purpose and types
    a. Balance crankshaft
    b. Types
        (1) Viscous
        (2) Balancer
2. Removal procedure
    a. Manufacturer's procedures
    b. Damage control

VALUE/ATTITUDE CONCEPTS: Awareness of following correct specifications and procedure for type of equipment.

TASK AREA: Diesel Engines

TASK #177: Inspects flywheel for wear, cracks and ring gear condition and makes decision on repairs.

COMPETENCY: Visually inspect flywheel and check with instruments to determine if flywheel meets manufacturer's specifications.

CRITERION: Can visually check flywheel for cracks and ring gear wear and make decision for reuse.

Can properly select test instruments to determine if surface and drive lugs are within manufacturer's specifications.

SKILL/PROCESS:

1. Visually inspect flywheel and ring gear
2. Measure clutch surface for flatness and pot depth for two-plate clutches
3. Measure drive lugs for thickness and for being square with clutch surface of flywheel

KNOWLEDGE/THEORY:

1. Purpose
    a. Weight to crankshaft
        (1) Provides momentum
        (2) Provides smoothness of operation
    b. Supports ring gear
        (1) Ring gear for engaging with starter
        (2) Types and construction
    c. Support for clutch disc
    d. Location
    e. Relationship to transmission
2. Weights
    a. Type of engine
    b. Number of cylinders
3. Types of damage
    a. Cracks
        (1) Visual
        (2) Magnaflux
    b. Burnt spots
    c. Holes and waller-outs
4. Repair
    a. Resurfacing clutch area
    b. Replacing ring gear

VALUE/ATTITUDE CONCEPTS: See general list on Page 11.

TASK AREA: Diesel Engines

TASK #178: Inspects, repairs, and installs flywheel housing and installs housing centered to crankshaft.

COMPETENCY: Visually inspect for damage to mating surfaces and bolt holes, make necessary repairs, use proper measuring instruments to center housing according to manufacturer's specifications.

CRITERION: Can visually inspect surfaces and bolt holes for damage and make decision on type of repairs needed.

Can properly select and make necessary repairs to damaged bolt holes.

Can install and torque flywheel housing to manufacturer's specifications.

Can select test instruments and test to determine if flywheel housing is within specifications, limits for run-out, and parallelism.

SKILL/PROCESS:

1. Visually inspect mounting surfaces and bolt holes
2. Install appropriate thread repair inserts
3. Install flywheel housing and gaskets and torque to specifications
4. Check transmission mounting surfaces with a dial indicator for run-out

KNOWLEDGE/THEORY:

1. Purpose
   a. Provide support between engine and transmission
   b. Houses
      (1) Flywheel
      (2) Clutch
      (3) Pressure plate
      (4) Release bearing and fork
   c. Centers crankshaft and front main drive
2. Inspection
   a. Bolt holes
   b. Surfaces
   c. Cracks
3. Alignment

VALUE/ATTITUDE CONCEPTS: Awareness of aligning properly when installing.

TASK AREA: Diesel Engines

TASK #179: Inspects machine work on reconditioned flywheel, installs ring gear, mounts flywheel and checks run-out.

COMPETENCY: Inspect machine work on recondition flywheel with measuring instruments to assure flywheel dimensions are within manufacturer's specifications and install ring gear and mount flywheel so lateral and radial run-out are within specifications.

CRITERION: Can inspect machine work with measuring instruments to assure flywheel dimensions are within specifications.

Can install ring gear to flywheel and mount to crankshaft.

Can check lateral and radial run-out to determine if flywheel is within manufacturer's specifications.

SKILL/PROCESS:

1. Visually inspect and with micrometer and dial indicators determine serviceability of reconditioned flywheel
2. Select proper drive lugs and install square to flywheel face (when applicable)
3. Select proper ring gear (size and gear teeth)
4. Properly heat, install, and secure ring gear to flywheel
5. Mount flywheel to crankshaft, checking timing and torque to specifications
6. Check lateral and radial round-out with dial indicator

KNOWLEDGE/THEORY:

1. Purpose
    a. Weight to crankshaft
        (1) Provides momentum
        (2) Provides smoothness of operation
    b. Supports ring gear
        (1) Ring gear for engaging with starter
        (2) Types and construction
    c. Support for clutch disc
    d. Location
    e. Relationship to transmission
2. Weights
    a. Type of engine
    b. Number of cylinders
3. Types of damage
    a. Cracks
        (1) Visual
        (2) Magnaflux
    b. Burnt spots
    c. Holes and waller-outs

4. Repair
    a. Resurfacing clutch area
    b. Replacing ring gear
5. Inspection
    a. Surfaces
        (1) Flatness
        (2) Run-out
    b. Ring gear teeth
        (1) Run-out
        (2) Size of teeth
    c. Lugs - for squareness with flywheel face

VALUE/ATTITUDE CONCEPTS: See general list on Page 11.

TASK AREA: Diesel Engines

TASK #180: Inspects camshaft for cracks, wear and warpage and makes decision on machine work.

COMPETENCY: Visually and with measuring instruments determine whether camshaft is serviceable or can be repaired.

CRITERION: Can visually recognize damage to camshaft which precludes reuse.

Can select measuring instruments and test to determine if camshaft bearing surfaces are within manufacturer's specifications.

Can measure to determine if cam lobes and shaft are within manufacturer's specifications.

SKILL/PROCESS:

1. Visually inspect surfaces for damage and serviceability
2. Magnetically inspect for metal defects
3. Check dimensions of lobes and bearings surfaces with micrometers and dial indicators to determine if within manufacturer's specifications
4. Check camshaft for warpage in lathe, v-blocks, or other suitable machine
5. Make determination of serviceability, machine work, or replacement

KNOWLEDGE/THEORY:

1. Function
    a. Open valves
    b. Timing
    c. Relation to other components
2. Parts
    a. Cam lobes
    b. Bearing surfaces
3. Types of damages
    a. Cracks
    b. Chips
    c. Worn keyway
    d. Thread damage
    e. Lobe wear
    f. Bearing surface wear
    g. Warpage
4. Machine work
    a. Resizing
    b. Straightening
5. Methods
    a. Visual
    b. Magnaflux
    c. Dial indicators
    d. Micrometer

VALUE/ATTITUDE CONCEPTS: See general list on Page 11.

TASK AREA: Diesel Engines

TASK #181: Inspects machine work on reconditioned camshafts, installs camshafts and adjusts end play to manufacturer's specifications.

COMPETENCY: Using measuring instruments, determine if camshaft meets manufacturer's specifications. Install camshaft and adjust end play using proper measuring instruments.

CRITERION: Can properly select measuring instruments to determine if camshaft bearings, lobes, and shaft are within manufacturer's specifications.

Can properly install camshaft and select measuring instruments to adjust end play to manufacturer's specifications.

Can install camshaft without bearing surface damage.

SKILL/PROCESS:

1. Measure lobes and bearing surfaces with micrometer
2. Install camshaft gear
3. Install camshaft in engine block without damage to bearing and proper timing to crankshaft
4. Check camshaft for proper bearing clearance and gear teeth lash
5. Check camshaft and/or adjust end play to manufacturer's specifications

KNOWLEDGE/THEORY:

1. Function
    a. Open valves
    b. Timing
    c. Relation to other components
2. Parts
    a. Cam lobes
    b. Bearing surfaces
3. Types of damages
    a. Cracks
    b. Chips
    c. Worn keyway
    d. Thread damage
    e. Lobe wear
    f. Bearing surface wear
    g. Warpage
4. Machine work
    a. Resizing
    b. Straightening
5. Methods
    a. Visual
    b. Magnaflux
    c. Dial indicators
    d. Micrometer
6. Checking end play
    a. Feeler gauge
    b. Dial indicator

7. Methods of correcting end play
    a. Shims
    b. Screw with rubbing block
    c. Thrust plates

VALUE/ATTITUDE CONCEPTS: See general list on Page 11.

TASK AREA: Diesel Engines

TASK #182: Inspects gear train, checks backlash and aligns timing marks.

COMPETENCY: Visually inspect gear train, check backlash, and align timing marks to specifications.

CRITERION: Can visually inspect gear train components for reuse.

Can check backlash and align timing marks to specifications.

SKILL/PROCESS:

1. Visually inspect gear train for serviceability
2. Visually check gear train to assure all gears are properly timed to each other
3. Make measurements with test instruments to assure proper backlash

KNOWLEDGE/THEORY:

1. Terms
    a. Gear train
        (1) Two or more gears connected
            (a) Drive
            (b) Driven
        (2) Transmits power
        (3) Synchronizes timing
    b. Timing marks
    c. Backlash - running clearance
2. Methods
    a. Feeler gauge
    b. Dial indicator

VALUE/ATTITUDE CONCEPTS: See general list on Page 11.

TASK AREA: Diesel Engines

TASK #183: Inspects lifters or followers for wear and cracks; replaces pins, bushings and rollers; installs lifter assemblies; and inspects push rods and makes decision on reuse.

COMPETENCY: Inspect visually and with test and measuring instruments lifters or followers and make necessary repairs within manufacturer's specifications. Install lifter assemblies and adjust to specifications.

CRITERION: Can visually and with measuring instruments determine wear and metal defects and make decision on reuse.

Can select necessary parts and equipment to repair components following manufacturer's specifications.

Can install lifters or followers in block with proper lubrication to assure free movement.

Can use timing tool to properly time injector cam followers to piston movement on Cummins engines.

SKILL/PROCESS:

1. Inspect visually for damage or serviceability
2. Inspect magnetically for metal defects
3. Measure wear with measuring instruments
4. Make needed repairs to conform to manufacturer's specifications
5. Install lifts or followers in engine block with proper lubrication, gaskets (timed where necessary) to meet manufacturer's specifications

KNOWLEDGE/THEORY:

1. Function
    a. Parts of valve-train mechanism
    b. Transmits power to open valves
    c. Convert rotary motion to reciprocating motion
2. Types
    a. Hinge-type follower
    b. Mushroom-type
    c. Center-roller follower
3. Construction
    a. Mechanical
    b. Hydraulic
    c. Parts
        (1) Pins
        (2) Rollers
        (3) Bushings
        (4) Push rods
4. Types of wear and damage
    a. Flat surface
    b. Galling
    c. Pitting
    d. Sconing

VALUE/ATTITUDE CONCEPTS: See general list on Page 11.

TASK AREA: Diesel Engines

TASK #184: Inspects rocker arms and shafts for cracks and wear, reconditions wear surfaces, replaces shaft bushings, and installs assembly to head.

COMPETENCY: Inspect rocker arms and shafts for cracks and wear, recondition wear surfaces, replace shaft bushings, and install assembly to head to comply with manufacturer's specifications.

CRITERION: Can visually inspect rocker arms and shafts for cracks and wear.

Can recondition worn surfaces to meet manufacturer's specifications.

Can replace shaft bushings and install assembly to cylinder head according to manufacturer's specifications.

SKILL/PROCESS:

1. Visually inspect rocker arms and shafts
2. Grind rocker arm valve contact surfaces
3. Replace bushings in rocker arms
4. Replace worn rocker shaft
5. Reassemble components and install on head

KNOWLEDGE/THEORY:

1. Function
    a. Part of valve train
    b. Transmit motion to open valves
2. Parts and function
    a. Rocker arms
    b. Rocker arms shafts
    c. Bushings
    d. Springs
    e. Stands
3. Reconditioning or repair
    a. Surface rocker
    b. Rebush
    c. Replace shaft
    d. Thread reconditioning
4. Visual inspections

VALUE/ATTITUDE CONCEPTS: Awareness of following correct procedures to assure proper installation.

TASK AREA: Diesel Engines

TASK #185: Inspects cylinder head assembly and makes decision on repairs and reconditioning to rebuild the head assembly to manufacturer's specifications.

COMPETENCY: Visually, and with test instruments, check for damage and wear of cylinder head and all components and make decisions on repairs, reconditioning, and replacement of parts and rebuild head assembly to manufacturer's specifications.

CRITERION: Can visually check surfaces and component parts for surface damage or wear.

Can, with magnetic or dye penetrant, determine if cylinder head or valves contain defects and make decision for reuse or repairs.

Can select test equipment to pressure test cylinder head for cracks or leaks at injector tubes and make decision on reuse, repairs, or reconditioning to manufacturer's specifications.

Can visually, and with test instruments, determine if cylinder head surfaces are within manufacturer's specifications as to warpage or surface defects, and can make decision on whether to reuse or recondition to manufacturer's specifications.

Can select test instruments to determine condition of valve guides and make decision on reuse, replacement, or reconditioning to manufacturer's specifications.

Can properly select reconditioning equipment and recondition valve seats to manufacturer's specifications as to concentricity, width, and surface finish.

Can grind valves to meet manufacturer's specifications as to concentricity, margin, and surface finish.

Can select test instruments to determine if valve springs meet manufacturer's specifications as to straightness, full length, compressed length, and tension.

Can select test instruments to determine if rotators are reuseable.

Can assemble cylinder head components using recommended procedures.

Can select test instruments to determine valve spring installation height and adjust when necessary to manufacturer's specifications.

Can select test equipment to determine proper valves and valve seat sealing.

SKILL/PROCESS:

1. Visually inspect cylinder head components for surface damage or wear.
2. Magnetically or with dye penetrant test for metal defects.

3. Pressure check cylinder head for cracks or leaks at injectors using appropriate test equipment.
4. Remove, clean, install, and machine injector tube to manufacturer's specifications as to leakage and injector protrusion.
5. Measure cylinder head surfaces for warpage using proper test instruments; recondition warped, worn or surface damaged cylinder head using proper equipment to manufacturer's specifications.
6. Measure valve guides for wear using test instruments. Replace or recondition to manufacturer's specifications.
7. Refinish valve seat to correct angle and width to assure good sealing, cooling, and seating position on valve face.
8. Grind valve face to correct angle and surface finish to assure good sealing and conformance to manufacturer's specification as to angle, surface finish, and concentricity.
9. Measure and test valve springs for straightness, free length, compressed length, and tension.
10. Test valve rotators for proper action and serviceability.
11. Reassemble cylinder head with serviceable components and test valve seats and valves for sealings; check and adjust valve spring installed height.

KNOWLEDGE/THEORY:

1. Cylinder head assembly parts and function
    a. Rotary - rotates valve
    b. Valve spring - returns valve to closed position
    c. Valve keys - locks valve to cap
    d. Valve guide
        (1) Guides valve
        (2) Oil seal
    e. Valve bridge - open two valves simultaneously
    f. Valve bridge guide - positions valve bridge
    g. Valve seats - forms seal to close chamber
    h. Injector tube - seals injector
    i. Valves
        (1) Opens to intake air
        (2) Closes to seal chamber
        (3) Opens to allow exhaust of spent gas
    j. Cylinder head
        (1) Forms seal for combustion chamber
        (2) Contains valve assembly
        (3) Contains valve seats
        (4) Contains valve guides
2. Inspection and checking
    a. Cylinder head
        (1) Warpage
        (2) Guide diameter
        (3) Valve seats

- (a) Pits
- (b) Concentricity
- (4) Cracks
- b. Valves
  - (1) Stem
    - (a) Warpage
    - (b) Wear
    - (c) Flatness
  - (2) Head
    - (a) Concentricity
    - (b) Margin
    - (c) Seat face
- c. Springs
  - (1) Height
  - (2) Tensions
- d. Cleaning - injector tube
- 3. Test equipment and instruments
  - a. Magnaflux
  - b. Spring compression testor
  - c. Gauges and measuring tools
    - (1) Micrometer
    - (2) Dial indicator
    - (3) Feeler gauge
    - (4) Straightedge
- 4. Repair equipment
  - a. Valve seat grinder
  - b. Valve face grinder
  - c. Valve guide knurling tool
  - d. Injector tube remover and replacer
  - e. Seat cutter and replacer
- 5. Repair of cylinder heads (machine shop)
  - a. Resurfacing - by milling
  - b. Repair of cracks

VALUE/ATTITUDE CONCEPTS: See general list on Page 11.

TASK AREA: Diesel Engines

TASK #186: Inspects manifolds for cracks and mounting surfaces for warpage; installs new water, intake, and exhaust manifold gaskets; and installs thermostat and seal in water manifold.

COMPETENCY: Visually and with proper replacement and test equipment, determine if manifolds are within manufacturer's specifications. Install new gasket and seals to assure leaks. Properly install thermostat.

CRITERION: Can visually inspect manifolds for cracks and check surfaces with gauge for warpage.

Can use test equipment to determine if intake and exhaust manifolds are within manufacturer's specifications.

Can install new intake and exhaust gasket without leaks.

Can install proper thermostats in water manifold without leaks.

SKILL/PROCESS:

1. Visually inspect manifolds.
2. Check mounting surfaces with straightedge and feeler gauge.
3. Install manifolds on engine using new gaskets.
4. Select correct thermostat for engine, shutter, and for clutch combination.
5. Install thermostat.

KNOWLEDGE/THEORY:

1. Types and function
    a. Intake - transmits air to cylinders
    b. Exhaust - transmits spent gases to exhaust pipe
    c. Water - transmits water between heads
2. Construction
    a. Casting
    b. Machined mating surfaces
3. Problems
    a. Warpage
    b. Cracks
    c. Pitted surfaces
    d. Vacuum leaks
4. Test and inspections
    a. Visual
    b. Feeler gauge
    c. Straightedge

VALUE/ATTITUDE CONCEPTS: See general list on Page 11.

TASK AREA: Diesel Engines

TASK #187: Inspects gear covers, pans and sumps for cracks and mounting surfaces for warpage.

COMPETENCY: Visually and with measuring devices inspect gear covers, pans, and mounting surfaces and determine if within serviceable limits.

CRITERION: Can visually inspect gear covers, pans, and sumps for cracks and warpage to determine reuse or needed repairs.

Can select measuring devices to check gear covers and pans for serviceability or make necessary repairs to assure there will be no oil leakage.

SKILL/PROCESS:

1. Visually inspect covers and pans for cracks, dents, stripped threads, and other damage.
2. Check mounting surfaces with straightedge and feeler gauge.
3. Weld, solder, or braze damaged areas if appropriate.

KNOWLEDGE/THEORY:

1. Function
    a. Gear covers
        (1) Cover gears for protection
        (2) Provides place for timing seal
        (3) Auxiliary seal
    b. Pans and sumps - oil reservoir
2. Types of problems
    a. Warpages
    b. Cracks
    c. Holes - oil pan
    d. Damaged bolt holes
3. Repair
    a. Welding
    b. Brazing or soldering

VALUE/ATTITUDE CONCEPTS: See general list on Page 11.

TASK AREA: Diesel Engines

TASK #188: Makes repairs to damaged drain pluq threads.

COMPETENCY: Determine and make repairs to damaged drain plug threads to assure drain plug can secure and not leak.

CRITERION: Can visually inspect drain plug threads and determine if repairs can be made.

Can select repair parts and correct size tools to make repair.

Can make repair by taping, reaming, and/or thread repair insert.

Can check to assure plug seals to prevent fluid loss.

SKILL/PROCESS:

1. Visually inspect threads.
2. Re-tape damagedthreads if appropriate.
3. Install thread insert if appropriate.
4. Install plug and check for oil leaks.

KNOWLEDGE/THEORY:

1. Function
   Provide drainage of oil
2. Repair
   a. Re-threading
   b. Thread inserts

VALUE/ATTITUDE CONCEPTS: See general list on Page 11.

TASK AREA: Diesel Engines

TASK #189: Installs engine seals.

COMPETENCY: Install engine seals using correct tools to assure no damage to engine or new seal and determine that there are no leaks.

CRITERION: Can select correct tools for installing new seals.

Can select proper seals for engine.

Can install engine seals, following recommended procedures. to insure that there will be no leakage or damage to seal or shafts.

SKILL/PROCESS:

1. Inspect, deburr, or repair seal bores to assure no leakage or deformity when seals are installed
2. Install proper seal into bore using press or seal installation tools following recommended procedures to assure no damage to seal or bore
3. Check to assure seals are square in bore and to proper depth
4. Apply proper lubrication to seal lips when needed

KNOWLEDGE/THEORY:

1. Functions
    a. Seal and contaminants
    b. Seal in lubricants
2. Types and construction
    a. Lip type
    b. Rope type
    c. Lead type
3. Installation
    a. Removers
    b. Drivers
    c. Lubrication
    d. Deburring
    e. Sealing

VALUE/ATTITUDE CONCEPTS: Awareness of criticality of proper installation and using correct tools.

TASK AREA: Diesel Engines

TASK #190: Rebuilds and installs oil pump.

COMPETENCY: Inspect oil pump visually and with test instruments to determine clearances and pressures and make necessary repairs to conform to manufacturer's specifications when installed.

CRITERION: Can visually inspect oil pump parts to determine if reuseable.

Can determine clearances with measuring instruments and pressures with test instruments to determine if in compliance with manufacturer's specifications.

Can select correct parts for replacement, and rebuild or recondition pump to specifications.

Can install oil pump on engine and check for leakage.

SKILL/PROCESS:

1. Visually inspect pump for housing, gear, and shaft wear
2. Check gear backlash
3. Check gear to housing clearance
4. Install new gears and new bushings if appropriate.
5. Install pump on engine
6. Run engine and check for leaks and correct oil pressure

KNOWLEDGE/THEORY:

1. Function - deliver oil for engine lubrication
2. Types
    a. Spur gear pump
    b. Herringbone gear pump
    c. Vane pump
3. Inspection
    a. Measurement
        (1) Gear to wall clearance
        (2) End plate gear running clearance
    b. Pressure
    c. Flow
    d. Leakage
4. Mounting
    a. Internal
    b. External
5. Cleanliness

VALUE/ATTITUDE CONCEPTS: See general list on Page 11.

TASK AREA: Diesel

TASK #191: Inspects, removes, rebuilds and installs water pump.

COMPETENCY: Inspect water pump visually, by feel, and with test instruments to determine necessary repairs and rebuild to conform to manufacturer's specifications and reinstall on engine so pump functions correctly and does not leak.

CRITERION: Can visually, by feel, or with proper test equipment determine if water pump is reuseable or needs rebuilding.

Can properly drain cooling system, remove belts, and remove water pump to prevent damage to gasket surfaces and parts.

Can select parts and equipment to rebuild water pump following recommended practices and build to manufacturer's specifications to assure impeller to body clearance, bearing functioning, and no water leakage at seals or gaskets.

Can select parts and reinstall water pump to block following recommended procedures.

Can install belts and adjust tension to recommended specifications.

Can refill cooling system and test for leakage.

SKILL/PROCESS:

1. Secure vehicle and cab to gain access to engine.
2. Visually check for signs of leakage.
3. Turn water pump shaft and note bearing action and shaft play.
4. Drain coolant for removal of water pump.
5. Remove belts and/or retaining bolts and remove water pump without damage to block or pump housing.
6. Disassemble water pump using proper tools.
7. Clean all surfaces and bearing bores and inspect to determine serviceability.
8. Press bearings, seals, and impeller on shaft maintaining impeller to body clearance and shaft extension.
9. Clean and inspect water pump mounting surfaces on block.
10. Install water pump to block using new gaskets and adjust belts to proper tension.
11. Refill coolant system to proper level and chemical concentration.
12. Pressure test coolant system for leaks.

KNOWLEDGE/THEORY:

1. Functions of water pump
   Circulate coolant through engine
2. Types
   a. Centrifugal
   b. Belt driven
   c. Gear driven
   d. Shaft driven

3. Parts
    a. Housing
    b. Impeller
    c. Seals
    d. Shaft
    e. Bearings or bushings
4. Problems
    a. Seal leakage
    b. Bearing wear and seizure
    c. Corrosion

VALUE/ATTITUDE CONCEPTS: See general list on Page 11.

TASK AREA: Diesel Engines

TASK #192: Removes oil cooler core and tests; inspects housing and reassembles oil cooler.

COMPETENCY: Properly remove oil cooler core to prevent damage, and visually and with test equipment check core and housing for serviceability. Reassemble to insure no leakage of oil or water.

CRITERION: Can select proper tools for removal of cooler cores and remove core following recommended procedures.

Can select appropriate cleaning method for cooler core and clean and inspect gasket surfaces to determine reuse or whether to make necessary repairs.

Can select test equipment and specifications and test core and housing for leaks following recommended procedures.

Can select proper parts and lubrication and assemble core to housing following manufacturer's recommendations.

Can properly test reassembled unit to insure no internal or external water or oil leakage.

SKILL/PROCESS:

1. Remove cooler core from housing
2. Clean cooler core in solution that will not harm solder or non-ferrous parts
3. Clean and inspect gasket and o-ring surfaces
4. Test core for leaks in appropriate holding and sealing fixture
5. Assemble core in housing assuring that o-rings are lubricated
6. Pressure test assembled cooler

KNOWLEDGE/THEORY:

1. Function of oil cooler
   a. Acts as heat exchanger
   b. Maintains oil at satisfactory operating temperature
2. Types
   a. Tube type
   b. Plate type
3. Parts
   a. Housing
   b. Tubes
   c. O-ring seals
   d. Threaded holes
   e. End covers
4. Pressure test
5. Inspection
   a. Flared ends
   b. Flanges
      (1) Cracks
      (2) Nicks
   c. Mounting or housing surfaces for flatness
6. Repair
   a. Replacing o-rings

b. Soldering
c. Welding
d. Resurface mounting surfaces

VALUE/ATTITUDE CONCEPTS: See general list on Page 11.

TASK AREA: Diesel Engines

TASK #193: Inspects blower, makes decision on repairs, installs rebuild kit, makes clearance adjustment.

COMPETENCY: Visually and with measuring instruments, determine necessary repairs for blower, make repairs, and adjust to conform to manufacturer's specifications.

CRITERION: Can properly secure vehicle to run engine and test blower.

Can select test equipment to check seal condition and air box pressure.

Can select proper specifications for engine and application.

Can perform engine blower test according to manufacturer's recommendations and compare test results with specifications and make decision to reuse or rebuild.

Can remove blower from engine, without damage or contamination to engine.

Can select tools, measuring instrument, and specifications to rebuild blower.

Can disassemble blower following manufacturer's procedure to insure parts are not damaged.

Can select appropriate cleaning method and clean parts.

Can visually inspect housing, rotors and end plates, and make decision on reuse.

Can select needed replacement kit and parts, and assemble according to manufacturer's recommendations.

Can use test instruments to check end play, rotor clearances and adjust to manufacturer's specifications.

Can install blower and accessories to engine following manufacturer's recommendations.

Can return vehicle to proper operating condition.

SKILL/PROCESS:

1. Secure vehicle and cab for access to engine and engine testing
2. Install a manometer to air box and intake, perform test and determine functioning of blower when compared to manufacturer's specification for engine application
3. Remove intake piping and adapter for access to blower housing to view rotors and seals
4. Visually inspect rotors for damage and indications of seal leakage
5. Run engine and check seals for leakage

6. Make decision on reuse or rebuilding from test data and visual observation
7. Clean engine and blower area to prevent contamination of engine during blower removal
8. Remove fuel lines while preventing damage to fittings and remove governor linkage (when appropriate drain cooling system and remove hoses from water pump)
9. Remove quillshaft, mounting bolts, and blower assembly and cover engine and line openings
10. Remove fuel transfer pump, governor, and water pump when applicable
11. Disassemble blower in proper sequence and with proper tools (keep shims with proper gears)
12. Clean all parts with proper solvents or cleaning equipment
13. Inspect rotors, blower housing, end plates, and bearing bores for serviceability
14. Install new bearings and seals with proper tools and torque retainer plates to specifications
15. Install rotors properly timed into blower housing and attach end plates torquing to specified valve
16. Install shims and gears to rotor shaft using proper tools
17. Check rotor end clearance, check rotor-to-rotor clearance, check rotor-to-case clearance on both leading and trailing edges. Compare to specifications and adjust with shims behind gears as necessary
18. Attach sub-assemblies to blower housing, torquing to specified valves
19. Clean and inspect blower mounting surfaces on engine block
20. Install blower with new gasket to engine block, torquing to valves
21. Attach or install all lines, hoses, linkage and quillshaft to blower following manufacturer's recommendations
22. Adjust or reset rack control tubes to governor
23. Refill coolant system to proper level and chemical concentration (when applicable) and run engine checking for proper operation of governor, blower, oil, and coolant leakage

KNOWLEDGE/THEORY:

1. Function
   a. Supply air at pressure
   b. To evenly distribute air to cylinders
2. Component parts - major
   a. Housing
   b. End plates
   c. Rotors
   d. Timing gears
   e. Bearings

3. Wear and damage
    a. Bearings
    b. Seals
    c. End play

VALUE/ATTITUDE CONCEPTS:

Awareness of proper assembly procedure.

Awareness of precision, proper mating, and adjustment of components.

TASK AREA: Diesel Engines

TASK #194: Rebuild turbocharger.

COMPETENCY: Properly disassemble without damage to parts; clean using appropriate cleaning methods; inspect visually and with measuring instruments; and make necessary repairs to bring turbocharger to manufacturer's specifications.

CRITERION: Can select proper tool to disassemble turbocharger following recommended procedure to assure no damage occurs to parts.

Can identify turbine, rotor and shaft relationships so when reassembled, balance of unit is maintained.

Can select cleaning method and clean, make visual checks, and with measuring instrument can determine serviceability of parts.

Can select proper parts and assemble following manufacturer's recommendations to assure balance of rotating parts, bearing clearances, end play, and turbine-rotor to housing clearance are within specifications and there are no internal and external oil leaks.

SKILL/PROCESS:

1. Select specifications for make and model of turbocharger
2. Disassemble turbocharger using press and other appropriate tools. Identify compressor and turbine position on shaft for reassembly to maintain balance
3. Clean parts in chemicals suitable for ferrous and non-ferrous metals as appropriate
4. Visually inspect parts for serviceability
5. Measure shaft, bearing bores, bearings and other parts with micrometer and dial indicator as appropriate
6. Reassemble turbocharger, reposition compressor and turbine on shaft to location noted during disassembly
7. Check unit for shaft end play, radial play, and rotor to housing clearance
8. Check unit for oil leaks

KNOWLEDGE/THEORY:

1. Function
    a. Compress air to cylinder
    b. Evenly distribute air
2. Principles
    a. Increases oxygen supply
    b. Exhaust gas energy - heat expansion
3. Operation
    a. Exhaust turns impeller attached to turbine
    b. Turbine compresses air
4. Components
    a. Housing

b. Turbine wheel
c. Compressor wheel
d. Seals
e. Bearings

VALUE/ATTITUDE CONCEPTS: Awareness for criticality of maintaining proper balance of turbine.

TASK AREA: Servicing

TASK #194A: Service turbocharger.

COMPETENCY: Remove piping, visually inspect for damage, use dial indicator to check for radial play and end play of shaft, clean wheels using appropriate cleaning methods.

CRITERION: Can clean turbocharger exterior with appropriate cleaning agents to avoid contamination of assembly when taken apart.

Can remove all piping to turbocharger without damaging to get it out of the way for servicing.

Can select proper measuring instruments to check for radial play and end play of shaft to determine reuse or need of rebuilding.

Can reinstall piping and check to assure there are no air, exhaust, and oil leaks.

SKILL/PROCESS:

1. Clean exterior of turbocharger with proper cleaning agents to avoid contamination
2. Remove all piping without damage to turbocharger
3. Select proper measuring instruments
4. Check radial movement and end play of shaft
5. Clean compressor wheel with appropriate methods and reinstall piping to assure no air, exhaust, or oil leaks

KNOWLEDGE/THEORY:

1. Function
    a. Compress air to cylinder
    b. Evenly distribute air
2. Principles
    a. Increases oxygen supply
    b. Exhaust gas energy - heat expansion
3. Operation
    a. Exhaust turns impeller attached to turbine
    b. Turbine compresses air
4. Components
    a. Housing
    b. Turbine wheel
    c. Compressor wheel
    d. Seals
    e. Bearings
    f. Shaft
5. Servicing
    a. Visual inspections
        (1) Air piping - air loss
        (2) Clean and free of dirt
        (3) Gaskets
        (4) Lubrication leaks
    b. Measuring
        (1) Radial run-out
        (2) End play

VALUE/ATTITUDE CONCEPTS: Awareness of proper procedures.

TASK AREA: Diesel Engines

TASK #195: Removes accessory drive, replaces bearing, installs accessory drive and seals, and makes necessary adjustments.

COMPETENCY: Using the proper tools, remove the accessory drive; replace bearings, seals and gaskets to insure correct clearances; correct timing; and determine that there are no oil leaks.

CRITERION: Can select tools to remove engine and vehicle components to gain access to accessory drive unit.

Can remove accessory drive unit and visually, and also with measuring instruments, determine if shaft is reusable.

Can remove and install bearing according to manufacturer's recommendations to assure proper clearance and lubrication.

Can remove and install oil seal following recommended procedure to assure no oil leaks.

Can install accessory drive unit according to manufacturer's specifications, and to assure proper timing when necessary.

Can return vehicle to operational condition.

SKILL/PROCESS:

1. Secure vehicle and cab for access to engine
2. Clean engine and area around accessory drive so as not to contaminate engine when part is removed
3. Remove pulley with proper tools
4. Remove any components driven by accessory shaft
5. Remove accessory shaft, seals, and bearing with proper tools to avoid damage to block
6. Clean block surfaces and seal bores, inspect for damage, and make necessary corrections
7. Install new bearings, check for proper clearance with accessory shaft
8. Install new seal and lubricate properly
9. Install accessory shaft (properly timed where necessary), check for end play, and adjust to manufacturer's specification
10. Install pulley; cleaning seal area, install components driven by accessory drive; and adjust belts to proper tension
11. Run engine and check for oil leaks and operation of engine components

KNOWLEDGE/THEORY:

1. Function and operation
    - a. To provide power to accessories
        - (1) Compressor
        - (2) Transfer pumps

        - (3) Oil pumps
        - (4) Fuel pumps
        - (5) Tachometer
    - b. Timed
    - c. Powered off gear train (idler gears)
- 2. Servicing
    - a. End play
    - b. Gear lock
    - c. Bearing to shaft clearance
    - d. Timing

VALUE/ATTITUDE CONCEPTS: Awareness of proper procedures and cleanliness.

TASK AREA: Diesel Engines

TASK #196: Makes test and determines best means for repairing radiators.

COMPETENCY: Make visual checks and pressure test to determine where coolant loss occurs and then make decision on repairs. Remove and reinstall radiators following recommended procedures to assure no coolant leaks or radiator damage.

CRITERION: Can visually inspect and pressure test radiator to determine if repairs are necessary.

Can drain coolant and prepare vehicle for radiator removal.

Can remove radiator from vehicle following recommended procedures.

Can reinstall radiator following recommended procedures to assure no coolant leaks.

Can refill with coolant to proper level and specific gravity specifications.

SKILL/PROCESS:

1. Pressure test and visually check radiator
2. Secure vehicle and drain coolant for radiator removal
3. Remove radiator from vehicle
4. Reinstall radiator on vehicle
5. Refill with coolant to proper level
6. Test to assure no leaks

KNOWLEDGE/THEORY:

1. Function and operation
    a. Methods of cooling
        (1) Water cooling
        (2) Air cooling
    b. Purpose of cooling system
        (1) Transfer of heat
        (2) Maintain operating temperature
        (3) Protect lubricants
    c. Principles of cooling
        (1) Exchange medium
        (2) Air flow
    d. Types of cooling systems
        (1) Open system
        (2) Closed system
    e. Types of radiators
        (1) Inclined
        (2) Cantered
2. Cooling system construction
    a. Radiators
        (1) Surge tank
        (2) Water tubes
        (3) Bottom tanks
        (4) Fins
        (5) Pressure cap

        - (6) Pressure relief valve
        - (7) Shutters
    - b. Water pumps
    - c. Bypass
    - d. Temperature regulators
    - e. Fan
- 3. Coolants additives
    - a. Antifreeze
    - b. Alcohol
    - c. Chemical additives
- 4. Servicing
    - a. Hose and connections
    - b. Pressure caps
    - c. Pressure testing for leaks
    - d. Cleaning
    - e. Adjusting shutter systems
- 5. Repair
    - a. Soldering
    - b. Brazing
    - c. Replacement of core or tanks
- 6. Auxiliary coolers
    - Transmission cooling unit

VALUE/ATTITUDE CONCEPTS: Aware of safety practices in working with pressure hot water systems.

NOT INCLUDED IN THE
DIESEL VEHICLE MAINTENANCE
CURRICULUM

TASK AREA: Diesel Engines

TASK #196A: Removes and/or disassembles, tests, and installs water-to-water heat exchanger.

COMPETENCY: Properly remove, disassemble and use test equipment to check for leaks and rate of flow. Install heat exchanger to insure no water leaks.

CRITERION: Can select proper tools for removal of cooler cores and remove core following recommended procedures.

Can select appropriate cleaning method for cooler core and clean and inspect to determine reuse or whether to make repairs.

Can select test equipment and specifications and test core and housing for leaks.

Can reassemble as appropriate and replace zinc anodes.

TASK AREA: Diesel Fuel Systems

TASK #197: Removes and installs fuel injectors or nozzles.

TASK #198: Makes static setting to fuel system and cold valve adjustment.

COMPETENCY: Properly remove injectors or nozzle to prevent damage to unit or engine, clean injector or nozzle tubes, and install injectors or nozzles using proper measuring instruments and specifications to insure efficient engine operation.

CRITERION: Can properly secure vehicle for removal of injectors or nozzles.

Can properly clean engine to avoid contamination of internal parts of engine.

Can select tools for removal of valve covers (when necessary) and injector or nozzle.

Can properly remove nozzles or injectors, preventing damage to units or contamination of fuel system.

Can properly clean injector or nozzle tubes.

Can select proper replacement parts and install to manufacturer's specifications.

Can select measuring instruments and adjust to manufacturer's specifications to insure efficient engine operation.

SKILL/PROCESS:

1. Secure vehicle cab or hood for access to injectors and nozzles
2. Select proper tools for removing injector
3. Clean area around injector to prevent entry of dirt into engine
4. Remove injector without damage
5. Close all opening to avoid contamination of engine parts and fuel system
6. Properly clean injector
7. Clean injector tubes with proper tools
8. Install injector and torque to manufacturer's specifications
9. Select proper tools and measuring devices and adjust injectors for efficient engine operation
10. Run engine and check for leaks

KNOWLEDGE/THEORY:

1. Function of injectors
   a. Unit type
   b. Cummins
2. Function of nozzles
3. Techniques of injector and nozzles removal
   a. Cleaning
   b. Tools
   c. Care after removal
4. Techniques of cleaning injector or nozzle tubes
   a. Reamers
   b. Wire brushes
   c. Wooden dowels

5. Techniques of installation of injectors or nozzles
    a. O-ring, seals, or gasket installation
    b. Injector or nozzles hold downs
        (1) Types
        (2) Torquing
    c. Injector positioning
    d. Fuel pipes or high pressure lines
6. Techniques of injector adjustment
    a. Cummins
        (1) Dial indicator
        (2) Torque
        (3) "Feel" method (stop-top)
    b. Unit injector
7. Function and adjustment techniques of valves clearances
    a. Loaded valve bridge
    b. Unload valve bridge
    c. Types of adjustment
        (1) Rocker arm adjuster screws
        (2) Push rod adjusters
8. Unit injector rack adjustment
    a. Governor setting
        (1) Idle screw
        (2) Buffer screw
        (3) Low speed gap
        (4) Belleville washers
    b. Control tube
    c. Control rack
    d. Throttle delay mechanism

VALUE/ATTITUDE CONCEPTS:

Awareness of criticality of following procedure.

Awareness of criticality of cleanliness.

Awareness of criticality of adhering to specifications particularly in torquing.

TASK AREA: Diesel Fuel Systems

TASK #199: Checks fuel manifold pressure and/or timing, and checks air flow restriction and boost pressure.

TASK #204: Tests intake manifold pressures.

COMPETENCY: Using proper measurement instruments and test equipment, check fuel pressure and/or timing to manufacturer's specifications. Using proper test equipment, measure air flow restrictions and boost pressure to manufacturer's specifications.

CRITERION: Can properly secure vehicle for testing.

Can select specifications for engine and application.

Can select proper test equipment and install according to manufacturer's recommendations.

Can perform tests, record results and compare to manufacturer's specifications.

Can return vehicle to operating condition.

SKILL/PROCESS:

1. Secure vehicle for testing according to manufacturer's procedures
2. Select proper test equipment and install following manufacturer's procedures
3. Perform tests, record results, and compare to manufacturer's specifications to determine condition of system
4. Disconnect all test equipment and ready vehicle for road

KNOWLEDGE/THEORY:

1. Function of fuel injection systems
2. Principles of fuel injection pumps
    a. Cummins PT system
    b. Pump controlled system
    c. Unit injector system
    d. Distributor system
3. Techniques of timing Cummins PT system
    a. Torque method
    b. Dial indicator method
4. Techniques of timing pump controlled system
    a. Timing light
    b. Static timing
        (1) High pressure
        (2) Low pressure
        (3) Timing pins and gauges
5. Techniques of timing unit injector system
6. Techniques of timing distributor system
    a. Timing light
    b. Static settings
7. Techniques of testing intake restriction or boost pressure
    a. Pressure gauges
    b. Manometer
    c. Vacuum gauges

VALUE/ATTITUDE CONCEPTS:

Awareness of criticality in following correct procedures.

Awareness of criticality in cleanliness.

Awareness of safety in working with high pressure.

TASK AREA: Diesel Fuel Systems

TASK #200: Removes and installs high pressure fuel lines.

COMPETENCY: Remove and install high pressure lines without damage to lines, injectors, or injection pump to assure line will be properly routed and clamped and will not leak.

CRITERION: Can clean lines and system with appropriate cleaning agents to assure no contamination of fuel system.

Can remove lines with correct tools without damaging, cap lines and pump openings to prevent contamination.

Can remove securing devices and brackets from lines and engine.

Can select proper lines, route and install without damage or contamination.

Can torque fittings to specifications.

Can start engine and inspect fittings for leaks.

Can secure lines with brackets and fastening devices.

SKILL/PROCESS:

1. Clean lines and system with specified cleaning agent to assure no contamination of fuel system during removal of lines
2. Remove lines using correct tools and exercising care to prevent damage to line seats and pump openings
3. Remove securing devices and brackets from lines and engine
4. Select and install correct lines while exercising care not to damage or contaminate lines or fittings
5. Torque all fittings to specifications
6. Run engine to check for leaks
7. Secure lines with brackets and fastening devices

KNOWLEDGE/THEORY:

1. Function of high pressure fuel lines
   a. Delivery of fuel under high pressure
   b. Length effect on delivery of fuel
2. Types of high pressure line
   a. Material
   b. Sizes
   c. Connections
3. Techniques of removing high pressure lines
   a. Cleaning
   b. Contamination protection
   c. Correct tools
   d. Damage prevention to seats and pump opening
   e. Securing devices and brackets
4. Techniques in installing lines
   a. Contamination
   b. Proper lines size

c. Torquing of lines
d. Run engine
e. Test for leaks
f. Secure lines

VALUE/ATTITUDE CONCEPTS: Awareness of precaution in working with high pressure systems.

TASK AREA: Diesel Fuel Systems

TASK #201: Removes and installs injection pump.

TASK #157: Inspects, cleans, and lubricates fuel pump sub-assembly.

COMPETENCY: Properly remove injection pump to prevent damage to unit or engine, clean, install injection pump using proper measuring instruments and specifications to insure efficient engine operation.

CRITERION: Can clean line and system with appropriate cleaning agents to assure no contamination of fuel system on removal of pump.

Can remove lines and protect from contamination.

Can remove linkages from assembly.

Can remove pump from engine without damage to pump, engine, or components.

Can install pump in engine in accordance with manufacturer's specifications.

Can select manufacturer's specifications for timing of pump to the engine.

Can reconnect all fuel lines and oil lines without leakages.

Can reconnect and adjust linkages to assure engine operates according to manufacturer's specifications.

SKILL/PROCESS:

1. Clean lines and system with specified cleaning agent to prevent contamination of fuel system during pump removal
2. Remove lines and install dust caps/or devices
3. Remove linkages from assembly
4. Remove pump from engine exercising care not to damage pump, engine, or components
5. Install pump to engine in accordance with manual procedures
6. Select timing specifications and time pump to engine
7. Reconnect all fuel and oil lines and torque to specifications
8. Reconnect linkages and adjust to specifications

KNOWLEDGE/THEORY:

1. Techniques of removing injection pump
    a. Cleaning agent
    b. Contamination
    c. Linkages
    d. Pump removal
    e. Pump line opening
2. Techniques of installation of injection pumps
    a. Manual procedures
    b. Engine timing
    c. Lines connection

    - d. Torquing
    - e. Linkages
    - f. Adjustment
    - g. Throttle travel
    - h. High, low
3. Pump sub-assembly
    - a. Clean
    - b. Lubricates
    - c. Proper operation

VALUE/ATTITUDE CONCEPTS: Awareness of the criticality of cleanliness, precision fit and proper assembly for the operation of the fuel and injection pump.

TASK AREA: Diesel Fuel Systems

TASK #202: Removes and installs fuel supply pumps.

COMPETENCY: Remove and install fuel supply pump using proper tools to prevent damage to lines, fittings and pump; lines will be properly routed, clamped and will not leak.

CRITERION: Can clean lines and system with appropriate cleaning agents to assure no contamination of fuel system and fuel supply pump.

Can remove lines without damage and protect from contamination.

Can remove fuel supply pump without damage to assembly components.

Can install fuel supply pump according to manufacturer's procedures and specifications.

Can check fuel supply pump for proper operation using gauges and instruments to check for pressure and fuel flow.

Can connect fuel lines without damage and without leakage.

Can start engine and check system to assure there are no leaks.

SKILL/PROCESS:

1. Clean lines and system with specified cleaning agent to prevent contamination of fuel system during removal of pump
2. Remove lines while exercising care not to damage fittings or pump and install protective caps to prevent contamination
3. Remove pump while exercising care not to damage pump or assembly components
4. Install pump following manual procedures
5. Check fuel pump for proper operation using gauges and instruments to check for pressure and fuel flow
6. Start engine and check system for leaks

KNOWLEDGE/THEORY:

1. Techniques in removing supply pump
    a. Cleaning
    b. Proper tools
    c. Lines and fitting
    d. Removal of pump
2. Techniques of pump installation
    a. Cam-drive pumps
    b. Blower-drive pumps
    c. Auxiliary-drive pumps
3. Operational checks and testing
    a. Gauges
    b. Pressures
    c. Flow
    d. Leakage

VALUE/ATTITUDE CONCEPTS: Awareness of special concerns and reasons for cleanliness.

TASK AREA: Diesel Fuel Systems

TASK #203: Checks and adjusts engine governor high and low idle setting.

COMPETENCY: With engine at normal operating temperature, adjust engine governor high and low idle settings to manufacturer's specifications.

CRITERION: Can secure vehicle and gain access to engine governor.

Can check specifications for engine.

Can install tachometer and start engine to run to normal operating condition.

Can run engine to maximum rpm's and compare and adjust to specified rpm's.

Can check idle and adjust to specifications.

Can return vehicle to operating condition.

SKILL/PROCESS:

1. Secure vehicle and remove access panels to engine governor
2. Select specifications for engine
3. Install tachometer, start engine, bring to normal operating temperature
4. Run engine up to maximum rpm's and compare to specifications. Adjust as required
5. Check idle rpm and adjust to specifications
6. Ready vehicle for road

KNOWLEDGE/THEORY:

1. Purpose of governor setting
    a. Low setting
    b. High setting
2. Preparation of vehicle for governor adjustment
    a. Secure vehicle rear wheels
    b. Preparing access to governor
    c. Preparing engine for adjustment
3. Techniques in adjusting governor
    a. Specification
    b. Tachometer
    c. High rpm setting
    d. Low rpm setting

VALUE/ATTITUDE CONCEPTS: Awareness of the effect the operation of the governor has on maintenance, wear and safety.

TASK AREA: Diesel Fuel Systems

TASK #204: Tests intake manifold pressures.

Listed with Task #199

TASK AREA: Diesel Engines

TASK #205: Run in new or rebuilt diesel engine.

TASK #206: Test engine with dynamometer.

COMPETENCY: Using appropriate test equipment, follow manufacturer's recommended run-in procedures and make all tests to assure engine functions according to manufacturer's specifications.

CRITERION: Can secure engine on test stand or secure vehicle safely for engine run-in.

Can attach securing and safety devices according to recommended procedures.

Can select test instruments and test equipment and hook up in proper sequence according to recommended procedures and specifications.

Can start engine and run-in according to recommended procedures.

Can recognize visual and sound indicators of correct or improper performance of engine and can make quick decisions as to action to be taken; can read and interpret instruments and gauges at various stages of run-in and compare to manufacturer's recommendations; and can make decisions as to run-in process, adjustments to be made, additional work to be done, or continuation of run-in.

Can make decision on termination of run-in.

Can complete run-in and return engine and/or vehicle to correct condition.

SKILL/PROCESS:

1. Secure engine on test stand for safety
2. Select specification for engine
3. Select test instruments and hook up to engine following manufacturer's specifications
4. Start engine and make performance test to manufacturer's sequence
5. Make record of test results and compare to manufacturer's specifications
6. Remove engine from dynamometer and return to operational condition

KNOWLEDGE/THEORY:

1. Principles of the dynamometer
    a. Electric
    b. Eddy current
    c. Water brake
2. Function of test equipment
    a. Manometers
    b. Vacuum gauges
    c. Pressure gauges
3. Techniques of dynamometer testing

- a. Loading sequence
- b. Engine rpm
- c. Engine temperature
  - (1) Oil
  - (2) Water

4. Principles of engines
   - a. Lubrication system and bearings
   - b. Fuel system and combustion
   - c. Air intake system
   - d. Piston and ring function
   - e. Turbochargers and blowers
5. Techniques of engine testing
   - a. Horsepower/torque
   - b. Oil pressure
   - c. Smoke or exhaust emissions
   - d. Crankcase pressure
   - e. Manifold pressure
   - f. Intake restriction
   - g. Air box pressure
   - h. Leakage
     - (1) Oil
     - (2) Water
   - i. Abnormal noises
     - (1) Combustion
     - (2) Mechanical
       - (a) Upper-valve train
       - (b) Lower-rods/mains
       - (c) Accessories

VALUE/ATTITUDE CONCEPTS:

Awareness and appreciation for special safety precautions for securing engines and vehicle during testing.

Awareness of value of proper testing and run-in of new or rebuilt engine.

302

TASK AREA: Service

TASK #207: Drive tractor trailer for road test.

COMPETENCY: Drive tractor-trailer combination to verify owner's report of abnormal operation or to check that shop work was completed properly and abnormal operation is corrected.

CRITERION: Can perform pre-trip inspection to insure vehicle is safe to operate on the road.

Can operate vehicle in a safe manner insuring that trailer off-tracking does not cause side-swiping or collisions.

Can evaluate performance of engine, steering, brakes, transmission, and other components while driving.

SKILL/PROCESS:

1. Inspect tires, lights, brakes, and other safety items
2. Drive vehicle on streets or roads suitable for testing engine, brakes, or other components
3. Observe feel of the vehicle, sounds, vibrations, and other indications of operating performance

KNOWLEDGE/THEORY:

1. Purpose of road test
   a. Provides verification of operating conditions
   b. Provides test that cannot be simulated
   c. Provides checks for appropriate sounds
   d. Provides checks for weather and wind
2. Pre-trip inspection
   a. Tires and wheels
   b. Lights
   c. Brake operation
   d. Glass and mirrors
3. Driving vehicle
   a. Listen for sounds (normal and abnormal)
   b. Detect vibrations (normal and abnormal)
   c. Observe gauges
   d. Evaluate performance
4. Types of road testing
   a. Check steering
      (1) Alignment
      (2) Elimination of vibration
      (3) Response
   b. Engine performance
      (1) Governor function
      (2) Power and response
      (3) Performance under operating condition
      (4) Noise
   c. Transmission and drive trains
      (1) Proper shifting
      (2) Operating sounds
      (3) Leakages
   d. Braking
      (1) Braking force
      (2) Braking pull

- e. Lighting system
    - (1) Lights operating
    - (2) Vibration effects
- f. Accessory system
    - (1) Mirror alignment
    - (2) Heating and cooling
    - (3) Wiper operation
- g. Body
    - (1) Proper fit of components
    - (2) Wind noise
    - (3) Weather or water
    - (4) Rattles and vibration

VALUE/ATTITUDE CONCEPTS: Awareness of safe driving habits when operating vehicle on highway.

Awareness of customer's personal concern for vehicle.

APPENDIX A

DEPARTMENT OF
COMMUNITY COLLEGES
NORTH CAROLINA STATE BOARD OF EDUCATION
RALEIGH 27611

July 14, 1977

Dear Colleague:

The Department of Community Colleges is conducting a project to evaluate and update diesel truck and heavy equipment mechanics programs in the system. The first step in this project was to identify appropriate positions that may be held by graduates of these programs.

The second step in this project is to identify the tasks and the level of competency needed in order to perform satisfactorily as a diesel truck or heavy equipment mechanic. The enclosed is an inventory asking for your opinion about which competencies in these programs will be needed. Your opinion on this inventory will provide guidance for the evaluating and updating of the programs in the community college system.

You can assist in this project by completing the enclosed inventory. Please return the inventory in the stamped, self-addressed envelope. Your responses will be compiled with the responses of other individuals completing the inventory, with no individual responses identified. Please return by August 1, 1977.

Thank you very much for assisting in this project.

Sincerely,

Roger G. Worthington

Roger G. Worthington, Director
Program Development

RGW:dr

COMPETENCY BASED DIESEL CURRICULUM STUDY

TASKS PERFORMED BY DIESEL TRUCK AND HEAVY EQUIPMENT MECHANICS

The following is a list of tasks which may or may not be performed by persons in diesel mechanic occupations. Please use the following key to make your evaluation of the importance of each task. The person should possess:

1. no competency in this activity.
2. slight competency in this activity.
3. moderate competency in this activity.
4. considerable competency in this activity.
5. complete competency in this activity.

Please answer all questions. There are no right or wrong answers. What is important is how you rate each competency.

Please circle the rating (1-2-3-4-5) which best indicates your feelings as to the importance of each item. At times your exact feelings will not be represented, but select the answer nearest your feelings and do not omit any items.

1
2
3
4
5
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9
10

Definition: Competent (Webster) 1. Well qualified; capable; fit.

Competency (Webster) 2. Condition or quality of being competent.

	no	slight	moderate	considerable	complete	TASKS
11.	1	2	3	4	5	Constructs high pressure hydraulic flex lines.
12.	1	2	3	4	5	Properly constructs, flares and bends metal hydraulic tubing.
13.	1	2	3	4	5	Installs hydraulic lines.
14.	1	2	3	4	5	Checks hydraulic pump pressure and flow.
15.	1	2	3	4	5	Removes and replaces hydraulic pump.
16.	1	2	3	4	5	Disassembles and checks hydraulic pump.
17.	1	2	3	4	5	Reassembles and installs cartridge kit in hydraulic pumps.
18.	1	2	3	4	5	Cleans and purges hydraulic system.
19.	1	2	3	4	5	Replaces hydraulic filters.
20.	1	2	3	4	5	Runs hydraulic system and checks oil level.
21.	1	2	3	4	5	Visually checks hydraulic system for damage.
22.	1	2	3	4	5	Checks hydraulic component mounting and alignment.

	no	slight	moderate	considerable	complete	TASKS
23.	1	2	3	4	5	Removes and replaces hydraulic cylinder.
24.	1	2	3	4	5	Straightens and polishes hydraulic cylinder shaft.
25.	1	2	3	4	5	Repairs or rebuilds hydraulic cylinders.
26.	1	2	3	4	5	Tests hydraulic system for leaks (internal-external).
27.	1	2	3	4	5	Changes engine oil.
28.	1	2	3	4	5	Changes engine oil filters.
29.	1	2	3	4	5	Changes engine fuel filters.
30.	1	2	3	4	5	Services engine water filters.
31.	1	2	3	4	5	Services air filters.
32.	1	2	3	4	5	Lubricates chassis.
33.	1	2	3	4	5	Checks gear oil levels.
34.	1	2	3	4	5	Services radiator shutter system.
35.	1	2	3	4	5	Checks and inflates tires.
36.	1	2	3	4	5	Checks track and rollers.
37.	1	2	3	4	5	Services and tests batteries.
38.	1	2	3	4	5	Services exhaust system.
39.	1	2	3	4	5	Inspects and adjusts belts.
40.	1	2	3	4	5	Services vehicle lighting system.
41.	1	2	3	4	5	Services windshield wiper system.
42.	1	2	3	4	5	Performs vehicle safety inspection.
43.	1	2	3	4	5	Checks operation of cab heating and air conditioning system.
44.	1	2	3	4	5	Services cooling system.
45.	1	2	3	4	5	Removes and replaces battery cables or cable ends.
46.	1	2	3	4	5	Rebuilds electric starter motor.
47.	1	2	3	4	5	Performs starter ampere-draw test on vehicle.
48.	1	2	3	4	5	Removes and replaces starter motor.

	no	slight	moderate	considerable	complete	TASKS
49.	1	2	3	4	5	Services solenoid unit.
50.	1	2	3	4	5	Services series-parallel unit.
51.	1	2	3	4	5	Services air starter motor.
52.	1	2	3	4	5	Tests D.C. generator on vehicle.
53.	1	2	3	4	5	Removes and replaces D.C. generator.
54.	1	2	3	4	5	Rebuilds D.C. generator.
55.	1	2	3	4	5	Tests and adjusts D.C. regulator.
56.	1	2	3	4	5	Removes and replaces D.C. regulator.
57.	1	2	3	4	5	Tests alternator on vehicle.
58.	1	2	3	4	5	Removes and replaces alternator.
59.	1	2	3	4	5	Rebuilds alternator.
60.	1	2	3	4	5	Tests and adjusts alternator voltage regulator on vehicle.
61.	1	2	3	4	5	Repairs and tests alternator voltage regulator.
62.	1	2	3	4	5	Removes and replaces electrical relay.
63.	1	2	3	4	5	Removes, replaces or repairs turn signal unit.
64.	1	2	3	4	5	Rewires "7" way trailer plug and cord.
65.	1	2	3	4	5	Removes and replaces dash switches and gauges.
66.	1	2	3	4	5	Trouble shoots and repairs electrical systems.
67.	1	2	3	4	5	Services wheel bearings and seals.
68.	1	2	3	4	5	Installs and trues spoke wheels.
69.	1	2	3	4	5	Checks steering linkage.
70.	1	2	3	4	5	Rebuilds steering sector box.
71.	1	2	3	4	5	Adjusts steering sector box on vehicle.
72.	1	2	3	4	5	Repairs and/or adjusts drag link.
73.	1	2	3	4	5	Removes, replaces or repairs tie-rods.
74.	1	2	3	4	5	Removes and replaces steering shaft and bearings.

	no	slight	moderate	considerable	complete	TASKS
75.	1	2	3	4	5	Removes and replaces steering knuckle ball joint.
76.	1	2	3	4	5	Aligns front-end.
77.	1	2	3	4	5	Removes and replaces king pin and bushings.
78.	1	2	3	4	5	Removes and replaces front axle.
79.	1	2	3	4	5	Removes and replaces springs.
80.	1	2	3	4	5	Repairs or rebuilds spring assembly and shackles, hangers, pads.
81.	1	2	3	4	5	Removes and replaces torque arm bushings.
82.	1	2	3	4	5	Installs fish plate on broken frame member.
83.	1	2	3	4	5	Removes and installs cross-member on frame.
84.	1	2	3	4	5	Straightens or corrects damaged frame.
85.	1	2	3	4	5	Rebushs walking beam.
86.	1	2	3	4	5	Aligns tandem axle.
87.	1	2	3	4	5	Services fifth wheel.
88.	1	2	3	4	5	Tests air brake system.
89.	1	2	3	4	5	Removes and replaces various air valve components in system.
90.	1	2	3	4	5	Removes and replaces brake chamber diaphragm.
91.	1	2	3	4	5	Removes and replaces brake shoes.
92.	1	2	3	4	5	Relines brake shoes.
93.	1	2	3	4	5	Services air brake actuators, cam & wedge assemblies.
94.	1	2	3	4	5	Removes and replaces spring brakes.
95.	1	2	3	4	5	Repairs or rebuilds spring brakes.
96.	1	2	3	4	5	Removes, replaces and adjusts air governor.
97.	1	2	3	4	5	Adjusts brakes.
98.	1	2	3	4	5	Rebuilds hydraulic master cylinder.
99.	1	2	3	4	5	Rebuilds hydraulic wheel cylinder.

	no	slight	moderate	considerable	complete	TASKS
100.	1	2	3	4	5	Removes and repairs power brake unit.
101.	1	2	3	4	5	Balances tires.
102.	1	2	3	4	5	Services air brake system plumbing.
103.	1	2	3	4	5	Services air pressure relief valve.
104.	1	2	3	4	5	Steam cleans and blows out fins on oil cooler.
105.	1	2	3	4	5	Removes and pressure tests oil coolers.
106.	1	2	3	4	5	Disassembles, replaces "O" ring and reassembles oil coolers.
107.	1	2	3	4	5	Services hydraulic accumulators.
108.	1	2	3	4	5	Services hydraulic control valve bodies.
109.	1	2	3	4	5	Services hydraulic clutch mechanism.
110.	1	2	3	4	5	Removes and reinstalls transmission.
111.	1	2	3	4	5	Removes and reinstalls single plate clutch (transmission removed).
112.	1	2	3	4	5	Removes and reinstalls two plate clutch (transmission removed).
113.	1	2	3	4	5	Replaces flywheel drive lugs for two plate clutch.
114.	1	2	3	4	5	Aligns engine flywheel housing.
115.	1	2	3	4	5	Disassembles and rebuilds pressure plate.
116.	1	2	3	4	5	Relines clutch disc.
117.	1	2	3	4	5	Removes and reinstalls clutch release bearing.
118.	1	2	3	4	5	Replaces pilot bearing.
119.	1	2	3	4	5	Rebuilds 4 or 5 speed manual transmission for medium duty truck.
120.	1	2	3	4	5	Rebuilds auxiliary transmission.
121.	1	2	3	4	5	Removes, reinstalls, and adjusts transmission air shift mechanisms.
122.	1	2	3	4	5	Repairs air shift mechanism.

	no	slight	moderate	considerable	complete	TASKS
123.	1	2	3	4	5	Overhauls twin countershaft transmission.
124.	1	2	3	4	5	Overhauls three countershaft transmission.
125.	1	2	3	4	5	Replaces transmission input shaft separate from transmission overhaul.
126.	1	2	3	4	5	Replaces speedometer drive gear separate from transmission overhaul.
127.	1	2	3	4	5	Removes and reinstalls shift lever housing from transmission separate from transmission overhaul.
128.	1	2	3	4	5	Repairs shift lever housing.
129.	1	2	3	4	5	Removes and reinstalls remote shifter for cab-over.
130.	1	2	3	4	5	Repairs remote shifter.
131.	1	2	3	4	5	Removes and reinstalls automatic transmission.
132.	1	2	3	4	5	Overhauls automatic and/or power shift transmissions.
133.	1	2	3	4	5	Overhauls torque converter.
134.	1	2	3	4	5	Removes and reinstalls drive line.
135.	1	2	3	4	5	Properly sets angularity of drive line.
136.	1	2	3	4	5	Removes and replaces universal joints.
137.	1	2	3	4	5	Removes and reinstalls u-joint yoke.
138.	1	2	3	4	5	Removes and reinstalls drive line center bearings.
139.	1	2	3	4	5	Removes and reinstalls rear differential carrier assembly in tandem.
140.	1	2	3	4	5	Overhauls rear differential carrier assembly.
141.	1	2	3	4	5	Removes and reinstalls front differential carrier assembly in tandem.
142.	1	2	3	4	5	Overhauls front carrier.
143.	1	2	3	4	5	Removes and reinstalls power divider.
144.	1	2	3	4	5	Overhauls power divider.
145.	1	2	3	4	5	Overhauls limited slip differential.

	no	slight	moderate	considerable	complete	TASKS
146.	1	2	3	4	5	Replaces pinion seal separate from carrier overhaul.
147.	1	2	3	4	5	Removes and reinstalls two-speed shift unit.
148.	1	2	3	4	5	Repairs two-speed shift unit.
149.	1	2	3	4	5	Removes and reinstalls front drive axle transfer case.
150.	1	2	3	4	5	Overhauls transfer case.
151.	1	2	3	4	5	Overhauls final drive for off-road machine.
152.	1	2	3	4	5	Overhauls steering clutches.
153.	1	2	3	4	5	Removes and reinstalls power take-off unit.
154.	1	2	3	4	5	Repairs power take-off.
155.	1	2	3	4	5	Disassembles, cleans, inspects, reassembles and calibrates injection pumps.
156.	1	2	3	4	5	Disassembles, inspects, reassembles and tests fuel supply pump system.
157.	1	2	3	4	5	Inspects, cleans and lubricates fuel pumps sub-assembly.
158.	1	2	3	4	5	Disassembles, inspects, reassembles and tests governor system.
159.	1	2	3	4	5	Rebuilds and tests air fuel ratio valves.
160.	1	2	3	4	5	Tests fuel injectors.
161.	1	2	3	4	5	Rebuilds and tests fuel injector.
162.	1	2	3	4	5	Disassembles engine, cleans components and makes parts ready for inspection.
163.	1	2	3	4	5	Inspects block bores and surfaces and makes decisions on repairs.
164.	1	2	3	4	5	Makes repairs to block bores and surfaces.
165.	1	2	3	4	5	Inspects block machine work and installs cam bearings, core and gallery plugs.
166.	1	2	3	4	5	Inspects liner flanges, seal grooves and surfaces and makes decision on reuse.
167.	1	2	3	4	5	Reconditions liner bores by boring and/or honing.

	no	slight	moderate	considerable	complete	TASKS
168.	1	2	3	4	5	Cleans and inspects pistons and makes decision on reuse.
169.	1	2	3	4	5	Reconditions piston skirts and ring grooves.
170.	1	2	3	4	5	Cleans and inspects connecting rods and makes decision on reuse.
171.	1	2	3	4	5	Reconditions connecting rod bores, repairs slight twists and replaces pin bushings.
172.	1	2	3	4	5	Inspects crankshaft for cracks, wear and straightness and makes decision for machine work.
173.	1	2	3	4	5	Inspects machine work on reworked crankshaft.
174.	1	2	3	4	5	Installs crankshaft, piston coolers, liners, rings, pistons and rods, fitting all components to manufacturer's specifications.
175.	1	2	3	4	5	Makes in-frame inspection of bearing wear and installs new bearings.
176.	1	2	3	4	5	Removes, inspects and installs balancers and balance shafts and makes decision on reuse of harmonic balancers.
177.	1	2	3	4	5	Inspects flywheel for wear, cracks and ring gear condition and makes decision on repairs.
178.	1	2	3	4	5	Inspects flywheel housing and installs housing centered to crankshaft.
179.	1	2	3	4	5	Inspects machine work on reconditioned flywheel, installs ring gear, mounts flywheel and checks run out.
180.	1	2	3	4	5	Inspects camshaft for cracks, wear and warpage and makes decision on machine work.
181.	1	2	3	4	5	Inspects machine work on reconditioned camshafts, installs camshaft and adjusts end play to manufacturer's specification.
182.	1	2	3	4	5	Inspects gear train, checks backlash and aligns timing marks to specification.
183.	1	2	3	4	5	Inspects lifter and followers for wear and cracks; replaces pins, bushings and rollers; installs lifter assemblies in block; and inspects push rods and makes decision on reuse.
184.	1	2	3	4	5	Inspects rocker arms and shafts for cracks and wear, reconditions wear surfaces, replaces shaft bushings, and installs assembly to head.

	no	slight	moderate	considerable	complete	TASKS
185.	1	2	3	4	5	Inspects cylinder head, makes decision on replacement of guides, valves, valve seats, combustion chambers and injector tubes; reconditions head; tests injector tubes and valves for leakage.
186.	1	2	3	4	5	Inspects manifolds for cracks and mounting surfaces for warpage; installs new water, intake and exhaust manifold gaskets; and installs thermostat and seal in water manifold.
187.	1	2	3	4	5	Inspects gear covers, pans and sumps for cracks and mounting surfaces for warpage.
188.	1	2	3	4	5	Makes repairs to damaged drain plug threads.
189.	1	2	3	4	5	Installs engine seals.
190.	1	2	3	4	5	Removes, inspects, rebuilds and installs oil pump.
191.	1	2	3	4	5	Removes, inspects, rebuilds and installs water pump.
192.	1	2	3	4	5	Removes oil cooler core and tests it; inspects housing and reassembles oil cooler.
193.	1	2	3	4	5	Inspects blowers, makes decision on repairs, installs rebuild kit, makes clearance adjustment and installs blower.
194.	1	2	3	4	5	Removes turbo compressor housing, cleans compressor wheel, inspects bearing wear; and removes, rebuilds and installs turbo charger.
195.	1	2	3	4	5	Removes accessory drive, replaces bearing, installs accessory drive and seals, and makes necessary adjustments.
196.	1	2	3	4	5	Removes, tests and installs heat exchangers including radiators.
197.	1	2	3	4	5	Removes and installs fuel injectors.
198.	1	2	3	4	5	Installs injection fuel pump and nozzles or injectors; makes static setting to fuel system and cold valve adjustment.
199.	1	2	3	4	5	Checks fuel pressure and/or timing, and checks air flow restriction and boost pressure.
200.	1	2	3	4	5	Removes and installs high pressure fuel lines.
201.	1	2	3	4	5	Removes and installs injection pump.
202.	1	2	3	4	5	Removes and installs fuel supply pumps.

	no	slight	moderate	considerable	complete	TASKS
203.	1	2	3	4	5	Tests and adjusts high and low rpm.
204.	1	2	3	4	5	Tests intake manifold pressures.

PLEASE ADD TO THIS LIST ANY OTHER COMPETENCIES YOU FEEL DIESEL MECHANICS MAY NEED AND RANK EACH ONE YOU ADD.

205.	1	2	3	4	5	
206.	1	2	3	4	5	
207.	1	2	3	4	5	
208.	1	2	3	4	5	
209.	1	2	3	4	5	

PLEASE COMPLETE THE INFORMATION ON THE NEXT PAGE.

Curriculum No. V 0 1 3 V 0 2 6

Survey No. ☐☐☐

Please provide the following information.

---

1. Are you a:
   A. ____ Mechanic
   B. ____ Shop Foreman
   C. ____ Shop Supervisor
   D. ____ Shop Owner
   E. ____ Teacher
2. Are you employed in a:
   A. ____ Privately owned (independent) firm
   B. ____ Franchised Dealer
   C. ____ Company or corporation-owned firm doing company work only
   D. ____ Company or corporation-owned firm doing both public and company work
   E. ____ Community College or Technical Institute
3. Approximately how many mechanics and supervisors are there in the firm in which you are employed?
   A. ____ Up to 10 employees
   B. ____ 10 to 25 employees
   C. ____ 26 up
4. In what type of firm are you employed?
   A. ____ Farm Machinery
   B. ____ Truck Industry
   C. ____ Heavy Equipment Industry
   D. ____ Marine Industry
   E. ____ Engine Manufacture Dealership
   F. ____ Stationary Equipment

APPENDIX B - SURVEY DATA ANALYSIS

SURVEY DATA

CURRICULUM CODE NO. & TITLE V-013 & V-026 Diesel Truck and He[illegible]quipment Mec[illegible]nics

Orig. No.	Rank	TASKS	Total No. Responses (37)	MEAN							FREQUENCY (N) & PCT. OF FREQUENCY (ADJ.)									
				Group	Emplyr's	(N)	Emplye's	(N)	Educ's	(N)	1 (N)	1 Pct.	2 (N)	2 Pct.	3 (N)	3 Pct.	4 (N)	4 Pct.	5 (N)	5 Pct.
174	1	Installs crankshaft, piston coolers, liners, rings, pistons and rods, fitting all components to manufacturer's specifications.	37	4.595	4.692	(13)	4.417	(12)	4.667	(12)	0		1		3		6		27	
183	2	Inspects lifter and followers for wear and cracks; replaces pins, bushings and rollers; installs lifter assemblies in block; and inspects push rods and makes decision on reuse.	36	4.583	4.750	(12)	4.333	(12)	4.667	(12)	0		2		1		7		26	
176	3	Removes, inspects and installs balancers and balance shafts and makes decision on reuse of harmonic balancers.	37	4.568	4.769	(13)	4.333	(12)	4.583	(12)	0		2		1		8		26	
198	4	Installs injection fuel pump and nozzles or injectors; makes static setting to fuel system and cold valve adjustment.	36	4.556	4.667	(12)	4.333	(12)	4.667	(12)	0		1		3		7		25	
182	5	Inspects gear train, checks backlash and aligns timing marks to specification.	37	4.541	4.692	(13)	4.333	(12)	4.583	(12)	0		1		4		6		26	
175	6	Makes in-frame inspection of bearing wear and installs new bearings.	37	4.486	4.692	(13)	4.250	(12)	4.500	(12)	0		3		1		8		25	
166	6	Inspects liner flanges, seal grooves and surfaces and makes decision on reuse.	37	4.486	4.615	(13)	4.333	(12)	4.500	(12)	0		2		4		5		26	
168	8	Cleans and inspects pistons and makes decision on reuse.	37	4.459	4.615	(13)	4.250	(12)	4.500	(12)	0		3		3		5		26	
181	8	Inspects machine work on reconditioned camshafts, installs camshaft and adjusts end play to manufacturer's specification.	37	4.459	4.769	(13)	4.000	(12)	4.583	(12)	1		2		2		6		26	
184	8	Inspects rocker arms and shafts for cracks and wear, reconditions wear surfaces, replaces shaft bushings, and installs assembly to head.	37	4.459	4.692	(13)	4.083	(12)	4.583	(12)	0		2		4		6		25	
170	11	Cleans and inspects connecting rods and makes decision on reuse.	37	4.432	4.538	(13)	4.167	(12)	4.583	(12)	0		3		2		8		24	
177	11	Inspects flywheel for wear, cracks and ring gear condition and makes decision on repairs.	37	4.432	4.692	(13)	4.167	(12)	4.417	(12)	0		2		5		5		25	
190	11	Removes, inspects, rebuilds and installs oil pump.	37	4.432	4.538	(13)	4.000	(12)	4.750	(12)	0		1		4		10		22	
197	11	Removes and installs fuel injectors.	37	4.432	4.462	(13)	4.333	(12)	4.500	(12)	0		1		6		6		24	
200	15	Removes and installs high pressure fuel lines.	36	4.417	4.500	(12)	4.250	(12)	4.500	(12)	0		0		7		7		22	

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Orig. No.	Rank	TASKS	Total No. Responses (37)	MEAN							FREQUENCY (N) & PCT. OF FREQUENCY (ADJ.)									
				Group	Emplyr's	(N)	Emplye's	(N)	Educ's	(N)	1 (N)	1 Pct.	2 (N)	2 Pct.	3 (N)	3 Pct.	4 (N)	4 Pct.	5 (N)	5 Pct.
189	16	Installs engine seals.	37	4.405	4.538	(13)	4.167	(12)	4.500	(12)	0		0		6		10		21	
31	16	Services air filters.	37	4.405	4.462	(13)	4.333	(12)	4.417	(12)	0		3		5		3		26	
69	18	Checks steering linkage.	36	4.389	4.667	(12)	4.083	(12)	4.417	(12)	0		2		4		8		22	
201	18	Removes and installs injection pump.	36	4.389	4.583	(12)	4.167	(12)	4.417	(12)	0		1		7		5		23	
71	18	Adjusts steering sector box on vehicle.	36	4.389	4.750	(12)	3.917	(12)	4.500	(12)	0		2		3		10		21	
165	21	Inspects block machine work and installs cam bearings, core and gallery plugs.	37	4.378	4.769	(13)	3.750	(12)	4.583	(12)	2		1		3		6		25	
178	21	Inspects flywheel housing and installs housing centered to crankshaft.	37	4.378	4.615	(13)	4.083	(12)	4.417	(12)	0		3		4		6		24	
179	21	Inspects machine work on reconditioned flywheel, installs ring gear, mounts flywheel and checks run out.	37	4.378	4.692	(13)	4.000	(12)	4.417	(12)	0		3		3		8		23	
202	24	Removes and installs fuel supply pumps.	36	4.361	4.417	(12)	4.250	(12)	4.417	(12)	0		0		9		5		22	
186	25	Inspects manifolds for cracks and mounting surfaces for warpage; installs new water, intake and exhaust manifold gaskets; and installs thermostat and seal in water manifold	37	4.351	4.615	(13)	3.833	(12)	4.583	(12)	1		0		6		8		22	
180	26	Inspects camshaft for cracks, wear and warpage and makes decision on machine work.	36	4.333	4.538	(13)	3.818	(11)	4.583	(12)	1		3		2		7		23	
66	27	Trouble shoots and repairs electrical systems.	37	4.324	4.769	(13)	3.750	(12)	4.417	(12)	0		4		5		3		25	
203	28	Tests and adjusts high and low rpm.	37	4.297	4.462	(13)	3.750	(12)	4.667	(12)	0		2		7		6		22	
57	28	Tests alternator on vehicle.	37	4.297	4.692	(13)	3.583	(12)	4.583	(12)	0		1		7		9		20	
29	28	Changes engine fuel filters.	37	4.297	4.385	(13)	4.083	(12)	4.417	(12)	0		3		7		3		24	
137	28	Removes and reinstalls u-joint yoke.	37	4.297	4.462	(13)	4.000	(12)	4.417	(12)	0		0		10		6		21	
136	32	Removes and replaces universal joints.	36	4.278	4.462	(13)	4.000	(11)	4.333	(12)	0		0		11		4		21	
91	32	Removes and replaces brake shoes.	36	4.278	4.500	(12)	3.917	(12)	4.417	(12)	0		1		10		3		22	
72	32	Repairs and/or adjusts drag link.	36	4.278	4.583	(12)	4.167	(12)	4.083	(12)	0		2		6		8		20	
163	35	Inspects block bores and surfaces and makes decisions on repairs.	37	4.270	4.692	(13)	3.917	(12)	4.167	(12)	2		2		5		3		25	
173	35	Inspects machine work on reworked crankshaft.	37	4.270	4.385	(13)	3.833	(12)	4.583	(12)	2		2		3		7		23	

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Orig. No.	Rank	TASKS	Total No. Responses	MEAN							FREQUENCY (N) & PCT. OF FREQUENCY (ADJ.)									
			(37)	Group	Emplyr's	(N)	Emplye's	(N)	Educ's	(N)	1 (N)	1 Pct.	2 (N)	2 Pct.	3 (N)	3 Pct.	4 (N)	4 Pct.	5 (N)	5 Pct.
185	35	Inspects cylinder head, makes decision on replacement of guides, valves, valve seats, combustion chambers and injector tubes; reconditions head; tests injector tubes and valves for leakage.	37	4.270	4.615	(13)	4.000	(12)	4.167	(12)	1		3		4		6		23	
67	35	Services wheel bearings and seals.	37	4.270	4.615	(13)	4.167	(12)	4.000	(12)	0		1		9		6		21	
28	35	Changes engine oil filters.	37	4.270	4.308	(13)	4.083	(12)	4.417	(12)	0		4		6		3		24	
44	40	Services cooling system.	36	4.250	4.667	(12)	3.417	(12)	4.667	(12)	1		4		3		5		23	
199	40	Checks fuel pressure and/or timing, and checks air flow restriction and boost pressure.	36	4.250	4.500	(12)	3.667	(12)	4.583	(12)	1		3		2		10		20	
47	42	Performs starter ampere-draw test on vehicle.	37	4.243	4.538	(13)	3.750	(12)	4.417	(12)	0		2		8		6		21	
99	42	Rebuilds hydraulic wheel cylinder.	37	4.243	4.154	(13)	4.083	(12)	4.500	(12)	1		1		4		13		18	
172	42	Inspects crankshaft for cracks, wear and straightness and makes decision for machine work.	37	4.243	4.154	(13)	4.000	(12)	4.583	(12)	2		3		3		5		24	
73	45	Removes, replaces or repairs tie-rods.	36	4.222	4.667	(12)	4.167	(12)	3.833	(12)	1		1		7		7		20	
112	45	Removes and reinstalls two plate clutch (transmission removed).	36	4.222	4.500	(12)	3.833	(12)	4.333	(12)	0		3		5		9		19	
140	45	Overhauls rear differential carrier assembly.	36	4.222	4.667	(12)	3.667	(12)	4.333	(12)	1		4		4		4		23	
65	44	Removes and replaces dash switches and gauges.	37	4.216	4.462	(13)	3.667	(12)	4.500	(12)	0		2		8		7		20	
27	48	Changes engine oil.	37	4.216	4.308	(13)	4.000	(12)	4.333	(12)	0		4		7		3		23	
37	48	Services and tests batteries.	37	4.216	4.231	(13)	3.750	(12)	4.667	(12)	0		2		10		3		22	
111	48	Removes and reinstalls single plate clutch (transmission removed).	37	4.216	4.538	(13)	3.833	(12)	4.250	(12)	0		3		7		6		21	
162	48	Disassembles engine, cleans components and makes parts ready for inspection.	37	4.216	4.538	(13)	3.667	(12)	4.417	(12)	1		1		8		6		21	
191	48	Removes, inspects, rebuilds and installs water pump.	37	4.216	4.154	(13)	4.000	(12)	4.500	(12)	1		1		6		10		19	
195	54	Removes accessory drive, replaces bearing, installs accessory drive and seals, and makes necessary adjustments.	36	4.194	4.333	(12)	3.917	(12)	4.333	(12)	0		3		5		10		18	
98	54	Rebuilds hydraulic master cylinder.	36	4.194	4.083	(12)	4.000	(12)	4.500	(12)	1		1		5		12		17	
192	56	Removes oil cooler core and tests it; inspects housing and reassembles oil cooler.	37	4.189	4.385	(13)	3.750	(12)	4.417	(12)	0		2		8		8		19	

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Orig. No.	Rank	TASKS	Total No. Responses	MEAN							FREQUENCY (N) & PCT. OF FREQUENCY (ADJ.)									
			(37)	Group	Emplyr's	(N)	Emplye's	(N)	Educ's	(N)	1 (N)	1 Pct.	2 (N)	2 Pct.	3 (N)	3 Pct.	4 (N)	4 Pct.	5 (N)	5 Pct.
45	56	Removes and replaces battery cables or cable ends.	37	4.189	4.308	(13)	3.833	(12)	4.417	(12)	0		4		7		4		22	
23	56	Removes and replaces hydraulic cylinder.	37	4.189	4.154	(13)	3.833	(12)	4.583	(12)	0		3		7		7		20	
92	59	Relines brake shoes.	36	4.167	4.083	(12)	4.000	(12)	4.417	(12)	1		1		10		3		21	
135	59	Properly sets angularity of drive line.	36	4.167	4.083	(12)	4.000	(12)	4.417	(12)	1		2		6		8		19	
118	61	Replaces pilot bearing.	37	4.162	4.385	(13)	3.667	(12)	4.417	(12)	0		2		11		3		21	
39	61	Inspects and adjusts belts.	37	4.162	4.308	(13)	3.667	(12)	4.500	(12)	0		4		7		5		21	
58	61	Removes and replaces alternator.	37	4.162	4.462	(13)	3.500	(12)	4.500	(12)	1		2		9		3		22	
33	61	Checks gear oil levels.	37	4.162	4.462	(13)	3.667	(12)	4.333	(12)	0		4		8		3		22	
88	65	Tests air brake system.	36	4.139	4.250	(12)	3.667	(12)	4.500	(12)	2		3		4		6		21	
19	66	Replaces hydraulic filters.	37	4.135	4.231	(13)	3.750	(12)	4.417	(12)	1		4		5		6		21	
110	66	Removes and reinstalls transmission.	37	4.135	4.308	(13)	3.833	(12)	4.250	(12)	1		3		6		7		20	
89	68	Removes and replaces various air valve components in system.	36	4.111	4.333	(12)	3.500	(12)	4.500	(12)	1		3		7		5		20	
48	69	Removes and replaces starter motor.	37	4.108	4.231	(13)	3.667	(12)	4.417	(12)	0		3		8		8		18	
56	69	Removes and replaces D.C. regulator.	37	4.108	4.154	(13)	3.750	(12)	4.417	(12)	1		1		10		6		19	
13	69	Installs hydraulic lines.	37	4.108	4.154	(13)	3.750	(12)	4.417	(12)	1		2		7		9		18	
20	69	Runs hydraulic system and checks oil level.	37	4.108	4.231	(13)	3.500	(12)	4.583	(12)	1		4		5		7		20	
21	69	Visually checks hydraulic system for damage.	37	4.108	4.308	(13)	3.500	(12)	4.500	(12)	2		3		3		10		19	
187	69	Inspects gear covers, pans and sumps for cracks and mounting surfaces for warpage.	37	4.108	4.385	(13)	3.583	(12)	4.333	(12)	1		0		12		5		19	
70	75	Rebuilds steering sector box.	36	4.083	4.500	(12)	3.667	(12)	4.083	(12)	1		3		6		8		18	
106	75	Disassembles, replaces "O" ring and reassembles oil coolers.	36	4.083	3.917	(12)	3.833	(12)	4.500	(12)	1		2		7		9		17	
52	77	Tests D. C. generator on vehicle.	37	4.081	4.538	(13)	3.500	(12)	4.167	(12)	0		2		10		8		17	
53	77	Removes and replaces D. C. generator.	37	4.081	4.231	(13)	3.667	(12)	4.333	(12)	1		2		10		4		20	
97	77	Adjusts brakes.	37	4.081	4.077	(13)	3.667	(12)	4.500	(12)	1		2		9		6		19	
18	80	Cleans and purges hydraulic system.	37	4.054	4.385	(13)	3.250	(12)	4.500	(12)	2		3		6		6		20	
32	80	Lubricates chassis.	37	4.054	4.308	(13)	3.750	(12)	4.083	(12)	0		4		10		3		20	

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Mechanics

Orig. No.	Rank	TASKS	Total No. Responses (37)	MEAN							FREQUENCY (N) & PCT. OF FREQUENCY (ADJ.)									
				Group	Emplyr's	(N)	Emplye's	(N)	Educ's	(N)	1 (N)	1 Pct.	2 (N)	2 Pct.	3 (N)	3 Pct.	4 (N)	4 Pct.	5 (N)	5 Pct.
193	80	Inspects blowers, makes decision on repairs, installs rebuild kit, makes clearance adjustment and installs blower.	37	4.054	3.923	(13)	3.583	(12)	4.667	(12)	3		2		2		13		17	
94	83	Removes and replaces spring brakes.	36	4.028	4.333	(12)	3.750	(12)	4.000	(12)	2		1		10		4		19	
114	83	Aligns engine flywheel housing.	36	4.028	4.583	(12)	3.417	(12)	4.083	(12)	2		2		6		9		17	
134	83	Removes and reinstalls drive line.	36	4.028	4.083	(12)	3.833	(12)	4.167	(12)	1		1		11		6		17	
141	83	Removes and reinstalls front differential carrier assembly in tandem.	36	4.028	4.250	(12)	3.750	(12)	4.083	(12)	2		2		7		7		18	
146	83	Replaces pinion seal separate from carrier overhaul.	36	4.028	4.083	(12)	3.750	(12)	4.250	(12)	1		2		8		9		16	
22	88	Checks hydraulic component mounting and alignment.	37	4.027	4.462	(13)	3.250	(12)	4.333	(12)	1		3		8		7		18	
25	88	Repairs or rebuilds hydraulic cylinders.	37	4.027	4.077	(13)	3.750	(12)	4.250	(12)	1		6		4		6		20	
160	88	Tests fuel injectors.	37	4.027	4.000	(13)	3.583	(12)	4.500	(12)	2		2		8		6		19	
167	88	Reconditions liner bores by boring and/or honing.	37	4.027	4.308	(13)	3.417	(12)	4.333	(12)	3		3		7		1		23	
40	92	Services vehicle lighting system.	37	4.000	4.154	(13)	3.583	(12)	4.250	(12)	1		2		11		5		18	
74	92	Removes and replaces steering shaft and bearings.	37	4.000	4.538	(13)	3.667	(12)	3.750	(12)	1		3		8		8		17	
93	92	Services air brake actuators, cam & wedge assemblies.	36	4.000	4.333	(12)	3.583	(12)	4.083	(12)	1		3		10		3		19	
113	92	Replaces flywheel drive lugs for two plate clutch.	36	4.000	4.250	(12)	3.750	(12)	4.000	(12)	1		3		8		7		17	
188	92	Makes repairs to damaged drain plug threads.	37	4.000	4.077	(13)	3.500	(12)	4.417	(12)	0		3		10		8		16	
204	92	Tests intake manifold pressures.	37	4.000	4.000	(13)	3.500	(12)	4.500	(12)	1		3		7		10		16	
38	98	Services exhaust system.	37	3.973	4.154	(13)	3.500	(12)	4.250	(12)	0		5		9		5		18	
60	98	Tests and adjusts alternator voltage regulator on vehicle.	37	3.973	4.308	(13)	3.167	(12)	4.417	(12)	2		3		8		5		19	
96	100	Removes, replaces and adjusts air governor.	36	3.972	4.083	(12)	3.333	(12)	4.500	(12)	2		2		8		7		17	
139	100	Removes and reinstalls rear differential carrier assembly in tandem.	36	3.972	4.083	(12)	3.667	(12)	4.167	(12)	2		3		7		6		18	
143	100	Removes and reinstalls power divider.	36	3.972	4.167	(12)	3.917	(12)	3.833	(12)	2		2		7		9		16	

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Orig. No.	Rank	TASKS	Total No. Responses (37)	MEAN Group	MEAN Emplyr's	(N)	MEAN Emplye's	(N)	MEAN Educ's	(N)	FREQUENCY (N) & PCT. OF FREQUENCY (ADJ.) 1 (N)	1 Pct.	2 (N)	2 Pct.	3 (N)	3 Pct.	4 (N)	4 Pct.	5 (N)	5 Pct.
194	100	Removes turbo compressor housing, cleans compressor wheel, inspects bearing wear; and removes, rebuilds and installs turbo charger.	36	3.972	3.833	(12)	3.667	(12)	4.417	(12)	3		3		3		10		17	
90	100	Removes and replaces brake chamber diaphragm.	36	3.972	4.000	(12)	3.583	(12)	4.333	(12)	1		3		11		2		19	
102	105	Services air brake system plumbing.	36	3.944	4.000	(12)	3.583	(12)	4.250	(12)	1		4		7		8		16	
144	105	Overhauls power divider.	36	3.944	4.167	(12)	3.667	(12)	4.000	(12)	3		3		6		5		19	
196	105	Removes, tests and installs heat exchangers including radiators.	36	3.944	4.083	(12)	3.583	(12)	4.167	(12)	2		2		7		10		15	
75	105	Removes and replaces steering knuckle ball joint.	36	3.944	4.417	(12)	3.833	(12)	3.583	(12)	2		2		8		8		16	
55	109	Tests and adjusts D. C. regulator.	37	3.919	4.538	(13)	2.917	(12)	4.250	(12)	1		4		7		10		15	
138	110	Removes and reinstalls drive line center bearings.	36	3.917	3.917	(12)	3.750	(12)	4.083	(12)	2		2		9		7		16	
15	111	Removes and replaces hydraulic pump.	37	3.892	3.846	(13)	3.417	(12)	4.417	(12)	1		3		10		8		15	
62	111	Removes and replaces electrical relay.	37	3.892	3.769	(13)	3.500	(12)	4.417	(12)	1		2		11		9		14	
142	113	Overhauls front carrier.	36	3.889	4.167	(12)	3.167	(12)	4.333	(12)	3		4		5		6		18	
125	113	Replaces transmission input shaft separate from transmission overhaul.	36	3.889	4.333	(12)	3.500	(12)	3.833	(12)	3		2		7		8		16	
169	115	Reconditions piston skirts and ring grooves.	37	3.865	4.231	(13)	3.167	(12)	4.167	(12)	4		2		7		6		18	
14	115	Checks hydraulic pump pressure and flow.	37	3.865	3.769	(13)	3.333	(12)	4.500	(12)	1		3		9		11		13	
17	115	Reassembles and installs cartridge kit in hydraulic pumps.	37	3.865	3.923	(13)	3.500	(12)	4.167	(12)	4		3		4		9		17	
117	115	Removes and reinstalls clutch release bearing.	37	3.865	3.769	(13)	3.500	(12)	4.333	(12)	3		3		8		5		18	
123	119	Overhauls twin countershaft transmission.	36	3.861	4.250	(12)	3.583	(12)	3.750	(12)	4		3		4		8		17	
132	119	Overhauls automatic and/or power shift transmissions.	36	3.861	4.000	(12)	3.250	(12)	4.333	(12)	3		4		5		7		17	
145	119	Overhauls limited slip differential.	36	3.861	4.167	(12)	3.000	(12)	4.417	(12)	4		4		4		5		19	
151	119	Overhauls final drive for off-road machine.	36	3.861	3.917	(12)	3.250	(12)	4.417	(12)	2		6		5		5		18	
153	119	Removes and reinstalls power take-off unit.	36	3.861	4.167	(12)	3.250	(12)	4.167	(12)	1		5		7		8		15	
158	119	Disassembles, inspects, reassembles and tests governor system.	36	3.861	3.833	(12)	3.250	(12)	4.500	(12)	6		2		3		5		20	

Orig. No.	Rank	TASKS	Total No. Responses (37)	MEAN Group	MEAN Emplyr's	(N)	MEAN Emplye's	(N)	MEAN Educ's	(N)	FREQUENCY (N) & PCT. OF FREQUENCY (ADJ.) 1 (N)	1 Pct.	2 (N)	2 Pct.	3 (N)	3 Pct.	4 (N)	4 Pct.	5 (N)	5 Pct.
16	125	Disassembles and checks hydraulic pump.	37	3.838	3.769	(13)	3.417	(12)	4.333	(12)	3		6		2		9		17	
34	126	Services radiator shutter system.	36	3.833	4.417	(12)	3.833	(12)	3.250	(12)	1		3		11		7		14	
119	126	Rebuilds 4 or 5 speed manual transmission for medium duty truck.	36	3.833	4.167	(12)	3.417	(12)	3.917	(12)	5		2		5		6		18	
164	128	Makes repairs to block bores and surfaces.	35	3.829	4.000	(12)	3.250	(12)	4.273	(11)	5		3		5		2		20	
41	129	Services windshield wiper system.	37	3.811	4.231	(13)	3.167	(12)	4.000	(12)	1		4		12		4		16	
103	130	Services air pressure relief valve.	36	3.806	4.167	(12)	3.083	(12)	4.167	(12)	3		3		8		6		16	
105	130	Removes and pressure tests oil coolers.	36	3.806	3.750	(12)	3.500	(12)	4.167	(12)	1		4		10		7		14	
157	130	Inspects, cleans and lubricates fuel pumps subassembly.	36	3.806	3.917	(12)	3.167	(12)	4.333	(12)	5		2		5		7		17	
42	133	Performs vehicle safety inspection.	36	3.778	4.167	(12)	3.583	(12)	3.583	(12)	3		2		10		6		15	
43	133	Checks operation of cab heating and air conditioning system.	36	3.778	4.333	(12)	3.417	(12)	3.583	(12)	1		3		11		9		12	
77	133	Removes and replaces king pin and bushings.	36	3.778	4.167	(12)	3.333	(12)	3.833	(12)	2		4		9		6		15	
120	133	Rebuilds auxiliary transmission.	36	3.778	4.000	(12)	3.417	(12)	3.917	(12)	6		2		4		6		18	
122	133	Repairs air shift mechanism.	36	3.778	4.167	(12)	3.417	(12)	3.750	(12)	5		3		3		9		16	
127	133	Removes and reinstalls shift lever housing from transmission separate from transmission overhaul.	36	3.778	4.000	(12)	3.583	(12)	3.750	(12)	3		3		7		9		14	
152	133	Overhauls steering clutches.	36	3.778	3.833	(12)	3.167	(12)	4.333	(12)	2		6		5		8		15	
156	133	Disassembles, inspects, reassembles and tests fuel supply pump system.	36	3.778	3.583	(12)	3.333	(12)	4.417	(12)	5		3		4		8		15	
26	141	Tests hydraulic system for leaks (internal-external).	37	3.757	4.000	(13)	2.917	(12)	4.333	(12)	3		6		5		6		17	
35	141	Checks and inflates tires.	37	3.757	3.923	(13)	3.250	(12)	4.083	(12)	2		6		10		0		19	
30	143	Services engine water filters.	36	3.750	3.833	(12)	3.750	(12)	3.667	(12)	2		6		7		5		16	
78	143	Removes and replaces front axle.	36	3.750	4.500	(12)	3.167	(12)	3.583	(12)	2		5		9		4		16	
121	143	Removes, reinstalls, and adjusts transmission air shift mechanisms.	36	3.750	4.167	(12)	3.417	(12)	3.667	(12)	5		3		4		8		16	
126	143	Replaces speedometer drive gear separate from transmission overhaul.	36	3.750	4.000	(12)	3.333	(12)	3.917	(12)	3		4		7		7		15	

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Orig. No.	Rank	TASKS	Total No. Responses (37)	MEAN							FREQUENCY (N) & PCT. OF FREQUENCY (ADJ.)									
				Group	Emplyr's	(N)	Emplye's	(N)	Educ's	(N)	1 (N)	Pct.	2 (N)	Pct.	3 (N)	Pct.	4 (N)	Pct.	5 (N)	Pct.
128	143	Repairs shift lever housing.	36	3.750	4.083	(12)	3.500	(12)	3.667	(12)	3		3		8		8		14	
161	143	Rebuilds and tests fuel injector.	36	3.750	3.417	(12)	3.417	(12)	4.417	(12)	4		4		6		5		17	
154	149	Repairs power take-off.	37	3.730	4.154	(13)	2.917	(12)	4.083	(12)	1		4		11		9		12	
100	150	Removes and repairs power brake unit.	36	3.722	3.667	(12)	3.333	(12)	4.167	(12)	3		5		6		7		15	
109	150	Services hydraulic clutch mechanism.	36	3.722	3.750	(12)	3.417	(12)	4.000	(12)	4		3		5		11		13	
159	150	Rebuilds and tests air fuel ratio valves.	36	3.722	3.583	(12)	3.167	(12)	4.417	(12)	4		5		4		7		16	
36	153	Checks track and rollers.	36	3.694	3.667	(12)	3.250	(12)	4.167	(12)	1		6		9		7		13	
108	154	Services hydraulic control valve bodies.	36	3.667	3.417	(12)	3.333	(12)	4.250	(12)	2		4		9		10		11	
131	154	Removes and reinstalls automatic transmission.	36	3.667	3.667	(12)	3.333	(12)	4.000	(12)	3		4		9		6		14	
129	156	Removes and reinstalls remote shifter for cab-over.	36	3.639	4.000	(12)	3.083	(12)	3.833	(12)	5		2		8		7		14	
46	157	Rebuilds electric starter motor.	37	3.622	4.000	(13)	2.667	(12)	4.167	(12)	2		7		5		12		11	
63	157	Removes, replaces or repairs turn signal unit.	37	3.622	3.692	(13)	3.250	(12)	3.917	(12)	2		4		13		5		13	
171	157	Reconditions connecting rod bores, repairs slight twists and replaces pin bushings.	37	3.622	3.846	(13)	2.833	(12)	4.167	(12)	6		2		9		3		17	
104	160	Steam cleans and blows out fins on oil cooler.	36	3.611	3.833	(12)	3.167	(12)	3.833	(12)	4		4		8		6		14	
49	161	Services solenoid unit.	37	3.595	3.692	(13)	3.167	(12)	3.917	(12)	2		3		12		11		9	
130	162	Repairs remote shifter.	36	3.583	4.000	(12)	3.083	(12)	3.667	(12)	5		3		7		8		13	
147	162	Removes and reinstalls two-speed shift unit.	36	3.583	3.750	(12)	3.333	(12)	3.667	(12)	5		2		8		9		12	
148	162	Repairs two-speed shift unit.	36	3.583	4.000	(12)	3.083	(12)	3.667	(12)	5		4		4		11		12	
150	162	Overhauls transfer case.	36	3.583	3.667	(12)	3.333	(12)	3.750	(12)	4		7		4		6		15	
149	166	Removes and reinstalls front drive axle transfer case.	36	3.556	3.583	(12)	3.583	(12)	3.500	(12)	4		6		5		8		13	
50	167	Services series-parallel unit.	37	3.541	3.462	(12)	3.083	(12)	4.083	(12)	3		4		10		10		10	
86	168	Aligns tandem axle.	36	3.528	4.000	(12)	3.083	(12)	3.500	(12)	6		1		9		8		12	
107	168	Services hydraulic accumulators.	36	3.528	3.583	(12)	2.750	(12)	4.250	(12)	3		4		11		7		11	
133	168	Overhauls torque converter.	36	3.528	3.333	(12)	3.000	(12)	4.250	(12)	6		5		5		4		16	
59	171	Rebuilds alternator.	37	3.514	4.000	(13)	2.500	(12)	4.000	(12)	4		5		10		4		14	

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Mechanics

Orig. No.	Rank	TASKS	Total No. Responses	MEAN							FREQUENCY (N) & PCT. OF FREQUENCY (ADJ.)									
											1		2		3		4		5	
			(37)	Group	Emplyr's	(N)	Emplye's	(N)	Educ's	(N)	(N)	Pct.	(N)	Pct.	(N)	Pct.	(N)	Pct.	(N)	Pct.
12	172	Properly constructs, flares and bends metal hydraulic tubing.	36	3.500	4.417	(12)	2.917	(12)	3.167	(12)	4		3		11		7		11	
64	172	Rewires "7" way trailer plug and cord.	36	3.500	4.000	(12)	3.083	(12)	3.417	(12)	5		4		9		4		14	
79	172	Removes and replaces springs.	36	3.500	3.917	(12)	3.1[illegible]	(12)	3.417	(12)	3		4		14		2		13	
124	175	Overhauls three countershaft transmission.	36	3.472	3.667	(12)	3.000	(12)	3.750	(12)	6		5		4		8		13	
54	176	Rebuilds D. C. generator.	37	3.459	3.615	(13)	2.667	(12)	4.083	(12)	4		6		8		7		12	
155	177	Disassembles, cleans, inspects, reassembles and calibrates injection pumps.	35	3.457	3.333	(12)	3.083	(12)	4.000	(12)	6		6		4		4		15	
95	178	Repairs or rebuilds spring brakes.	36	3.417	3.167	(12)	3.083	(12)	4.000	(12)	7		2		9		5		13	
61	179	Repairs and tests alternator voltage regulator.	37	3.405	3.615	(13)	2.917	(12)	3.667	(12)	4		6		10		5		12	
11	180	Constructs high pressure hydraulic flex lines.	36	3.361	4.250	(12)	3.000	(12)	2.833	(12)	6		3		10		6		11	
87	180	Services fifth wheel.	36	3.361	3.667	(12)	2.833	(12)	3.583	(12)	7		5		5		6		13	
81	182	Removes and replaces torque arm bushings.	36	3.306	3.917	(12)	2.833	(12)	3.167	(12)	5		4		14		1		12	
76	183	Aligns front-end.	36	3.278	3.417	(12)	2.750	(12)	3.667	(12)	8		3		7		7		11	
80	183	Repairs or rebuilds spring assembly and shackles, hangers, pads.	36	3.278	4.083	(12)	2.417	(12)	3.333	(12)	6		4		11		4		11	
68	185	Installs and trues spoke wheels.	36	3.222	3.667	(12)	2.667	(12)	3.333	(12)	10		4		3		6		13	
82	186	Installs fish plate on broken frame member.	36	3.139	3.500	(12)	2.667	(12)	3.250	(12)	7		5		9		6		9	
83	186	Removes and installs cross-member on frame.	36	3.139	3.500	(12)	3.000	(12)	2.917	(12)	6		5		12		4		9	
85	188	Rebushs walking beam.	35	3.086	3.086	(12)	2.833	(12)	3.364	(11)	7		5		10		4		9	
51	189	Services air starter motor.	36	3.028	3.167	(12)	2.583	(12)	3.333	(12)	6		9		5		10		6	
115	190	Disassembles and rebuilds pressure plate.	36	2.972	3.250	(12)	2.417	(12)	3.250	(12)	10		3		9		6		8	
24	191	Straightens and polishes hydraulic cylinder shaft.	36	2.944	3.250	(12)	2.750	(12)	2.833	(12)	9		6		7		6		8	
116	192	Relines clutch disc.	36	2.889	3.000	(12)	2.417	(12)	3.250	(12)	9		6		10		2		9	
101	193	Balances tires.	36	2.778	2.833	(12)	2.417	(12)	3.083	(12)	8		6		14		2		6	
84	194	Straightens or corrects damaged frame.	36	2.694	2.917	(12)	2.000	(12)	3.167	(12)	12		8		4		3		9	

APPENDIX C

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